Iron and Steel ENGINEER

ENGINEERING SERVICE
TO THE IRON AND STEEL
INDUSTRY SINCE 1907

CHNOLOGY DEPARTMENT

TABLE OF CONTENTS, Page 33

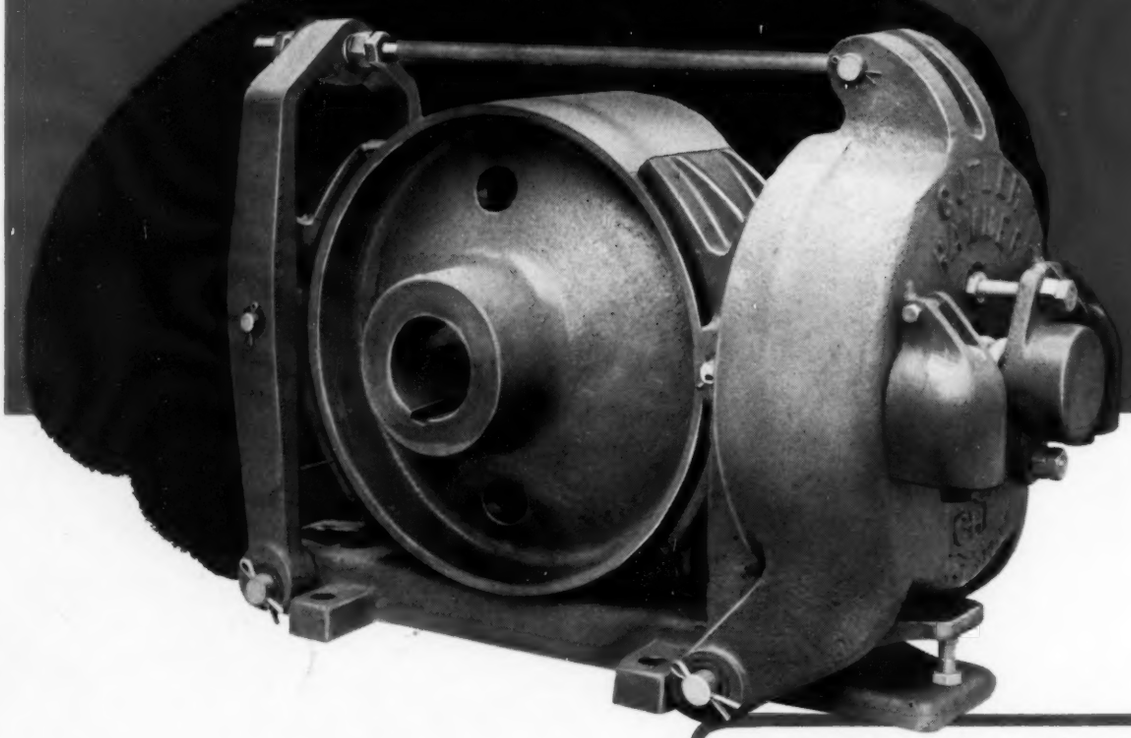
OCTOBER, 1947

160" FOUR-HIGH REVERSING PLATE MILL
designed and built by MESTA

DESIGNERS AND BUILDERS OF COMPLETE STEEL PLANTS
MESTA MACHINE COMPANY - PITTSBURGH, PA.

14 BASIC FACTS

Show this Mill Type D.C. Brake to have No Equal



14 fundamental facts illustrated in the new Cutler-Hammer Publication BR-2 will prove to any man the Type M Brake is the simplest, most durable and dependable brake ever built.

The action is a direct push of the shoes against the brake wheel without any intervening parts. Since the field member and armature member both move in braking and release, the action is lightning fast. The simple design eliminates the parts that usually cause trouble and necessitate adjustment and repair. The tough lining matched with rugged alloy steel wheel cuts down lining wear, and take-up adjustments are needed only at unusually long intervals. The Type M Brake has been proved on a great majority of heavy duty installations to have no equal in performance. You are invited to write for a copy of the informative Publication BR-2. It is free. CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wis. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

- **The simplest of all brakes**
- **The brake with the fastest action**
- **The *only* brake with one-to-one magnet and total shoe stroke**
- **Tough long-life lining matched with hard Hammerloy steel wheel**
- **Has the *fewest* parts**
- **The brake with *only* 3 simple adjustments**
- **Longest service without take-up adjustments**
- **Cover-all tubes shield *full length* of hinge pins against corrosion**
- **Renewable hardened hinge pin bushings**
- **Brass magnet coil cover plate caulked in place with babbitt wire**
- **Torque spring compression *CANNOT* be released manually**
- **Torque spring fully protected**
- **Brass friction plugs keep shoes always aligned**
- **Fundamental design proved by years of service in heavy duty applications**

All of these features are also provided, when used on A. C. Service with rectifier

CUTLER-HAMMER
MOTOR CONTROL
C-H

It Set the Pattern Years Ago
It has Set the Pace Ever Since

IRON AND STEEL ENGINEER, published monthly by Association of Iron and Steel Engineers, entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress, March 3, 1879. $7.50 per year in United States, $8.25 Canada, $10.00 foreign countries. Volume 24, No. 10.

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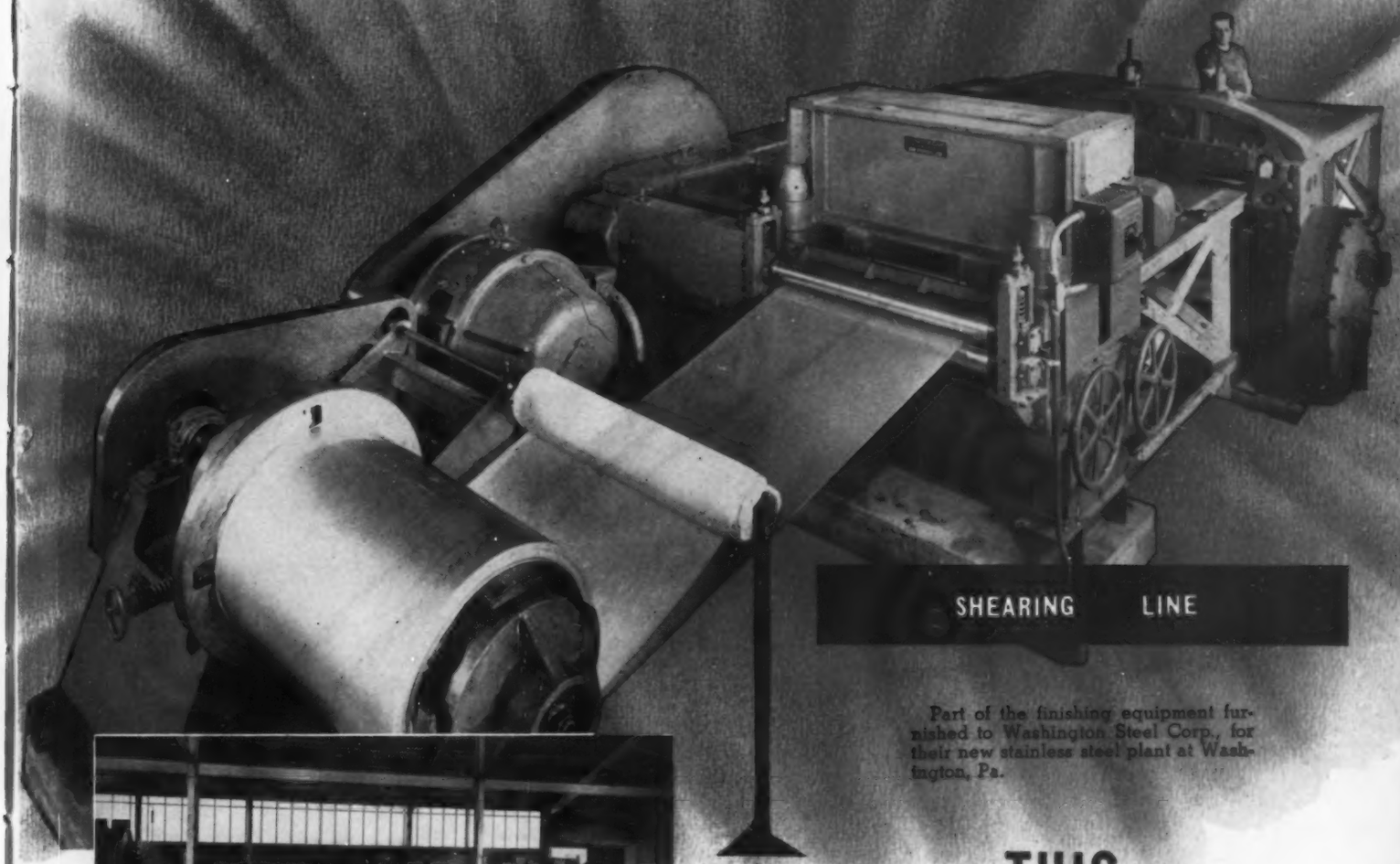
DETROIT

Planning new finishing equipment?



SHEARING LINE

Part of the finishing equipment furnished to Washington Steel Corp., for their new stainless steel plant at Washington, Pa.

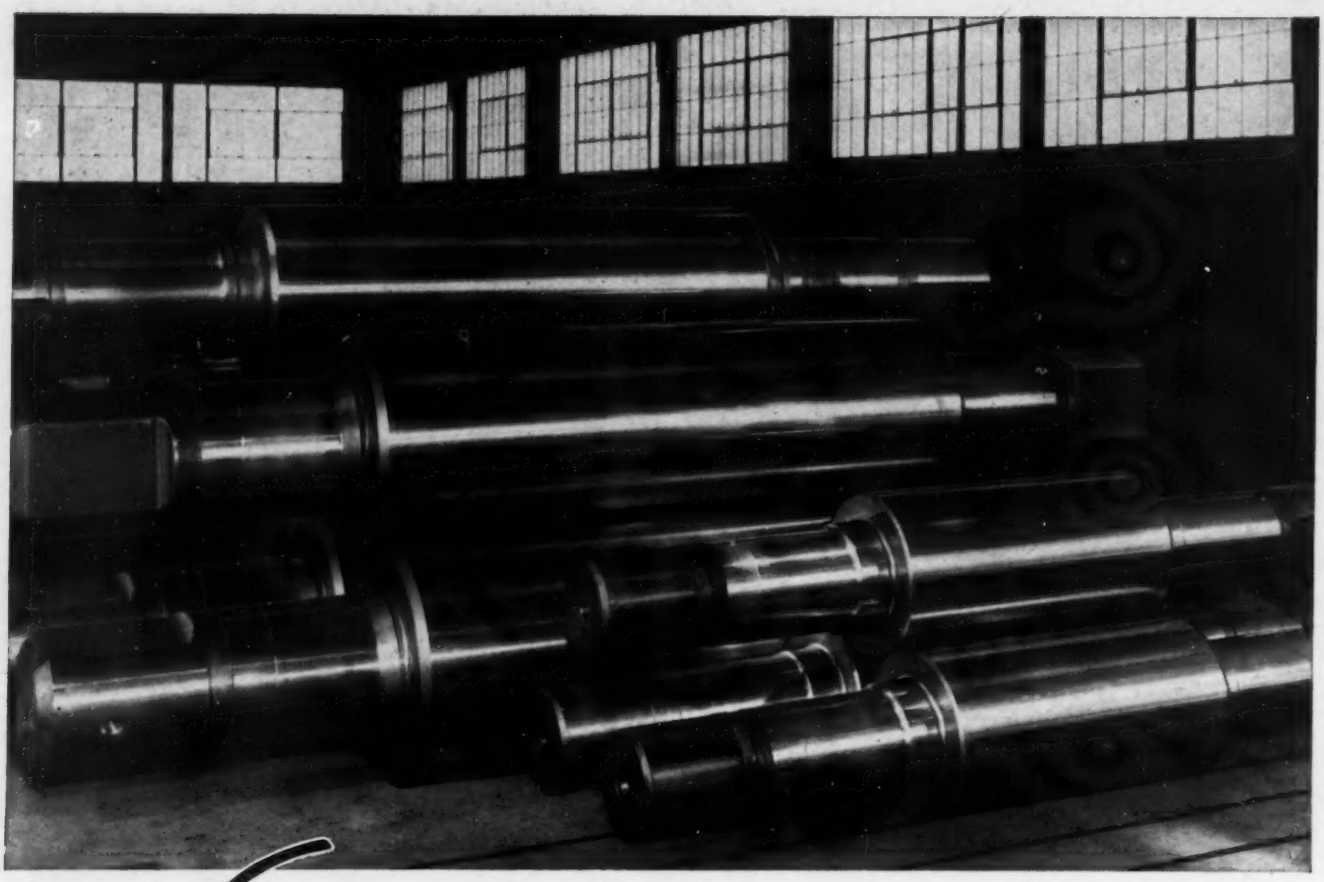
500,000 LB. HYDRAULIC STRETCHER LEVELLER

SIDE TRIMMING & SLITTING LINE

THIS new installation by AETNA-STANDARD may furnish some profitable ideas

THE AETNA-STANDARD ENGINEERING COMPANY
YOUNGSTOWN, OHIO

ASSOCIATED COMPANY: HEAD, WRIGHTSON & COMPANY, LTD., THORNABY-ON-TEES, ENGLAND



Experience makes them RIGHT!

The National organization, through knowledge accumulated over the years has the *right* answer to any specific roll problem. And to supplement this experience, National, today, is manned and equipped to turn out the type of rolls you need — when you need them.

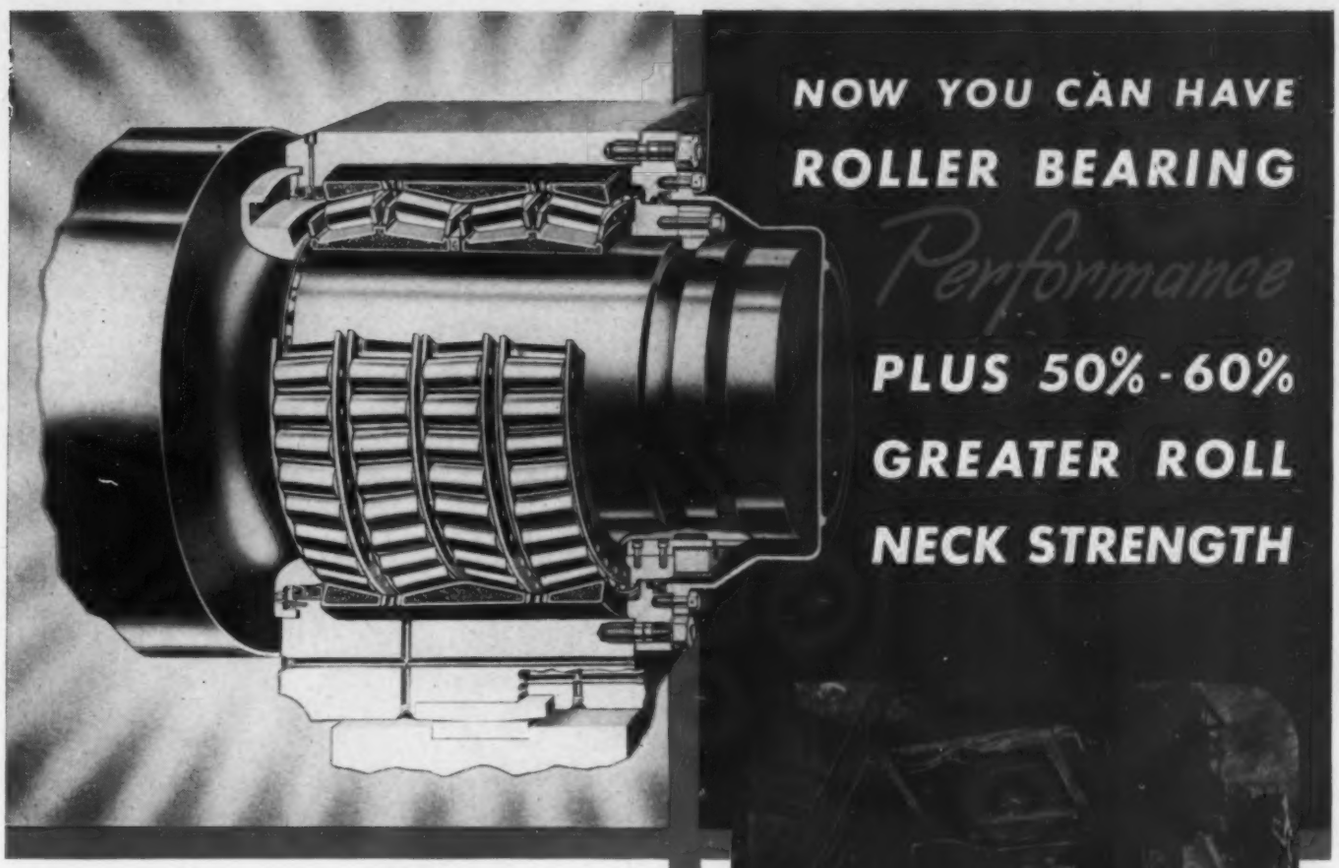
Here we combine the skill of the craftsman with the latest in metallurgical and manufacturing techniques; guard quality by precise laboratory control and rigid inspection.

By such careful attention to a multitude of details, National produces iron and alloy iron rolls that are soundly cast and have long wearing physical properties.

National Rolls

THE NATIONAL ROLL & FOUNDRY CO.
AVONMORE, PENNSYLVANIA

Manufacturing IRON AND ALLOY IRON ROLLS Exclusively



No type of bearing used on mill roll necks has ever equalled the all-around efficiency, simplicity and economy of the roller bearing as designed and manufactured by The Timken Roller Bearing Company.

Timken Balanced Proportion Roll Neck Bearings assure 50% to 60% increased roll neck strength with correspondingly decreased roll neck stress and deflection. These bearings also show load ratings up to 40% higher than previous designs of tapered roller bearings. For specific information consult your mill builder or our roll neck bearing specialists. Look for the trade-mark "TIMKEN" on every bearing you use. The Timken Roller Bearing Company, Canton 6, Ohio.

Painted for The Timken Roller Bearing Company by Peter Helck.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
ROLL NECK BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION →✳←

DURABLA

METAL PUMP VALVE UNITS GUARD AGAINST CORROSION

The corrosive fluids listed above represent just a small percentage of those on which data is available in the installation and service records of the DURABLA Engineering Department. Through the combination of distinctive design characteristics and the use of modern alloys, DURABLA Valve Units* are the only pump valves which can guard against all chemical hazards. They have been used as a safeguard against an almost unlimited number of corrosive fluids and gases, insuring long-term economy and freedom from breakdown in the operation of reciprocating pumps handling chemically active substances. The latest developments in protective alloys and long experience in dealing with this type of problem are available when you specify DURABLA Pump Valve Units.

Address DURABLA Engineering Department for Information and Bulletin, Reference 7S10

*Patent Numbers 2090486, 2117504

DURABLA MANUFACTURING COMPANY
114 LIBERTY ST. NEW YORK
BRANCHES IN PRINCIPAL CITIES. FOR CANADA REFER: CANADIAN DURABLA LIMITED, TORONTO

Appearance of oxygen-fuel flame in open hearth

Oxygen speeds open hearth combustion

Oxygen once again reveals the productive power it holds for mankind. Today it starts to unfold vast new opportunities in the Steel Industry. It may, in fact, change present day standards of open hearth production.

This new combustion technique, employing the oxygenated fuel flame, reduces meltdown time by accelerating the heat input rate. Airco has played an important role in initiating this development, and in assisting the steel industry in its research efforts. Airco is continuing to cooperate in working out specific application problems.

Cooperative research and development such as this exemplifies Airco's continuing effort to provide time-saving, product-improving tools and techniques for ALL industry. The facilities of our Technical Sales Division are available to you in applying Airco processes and products to the solution of your problems.

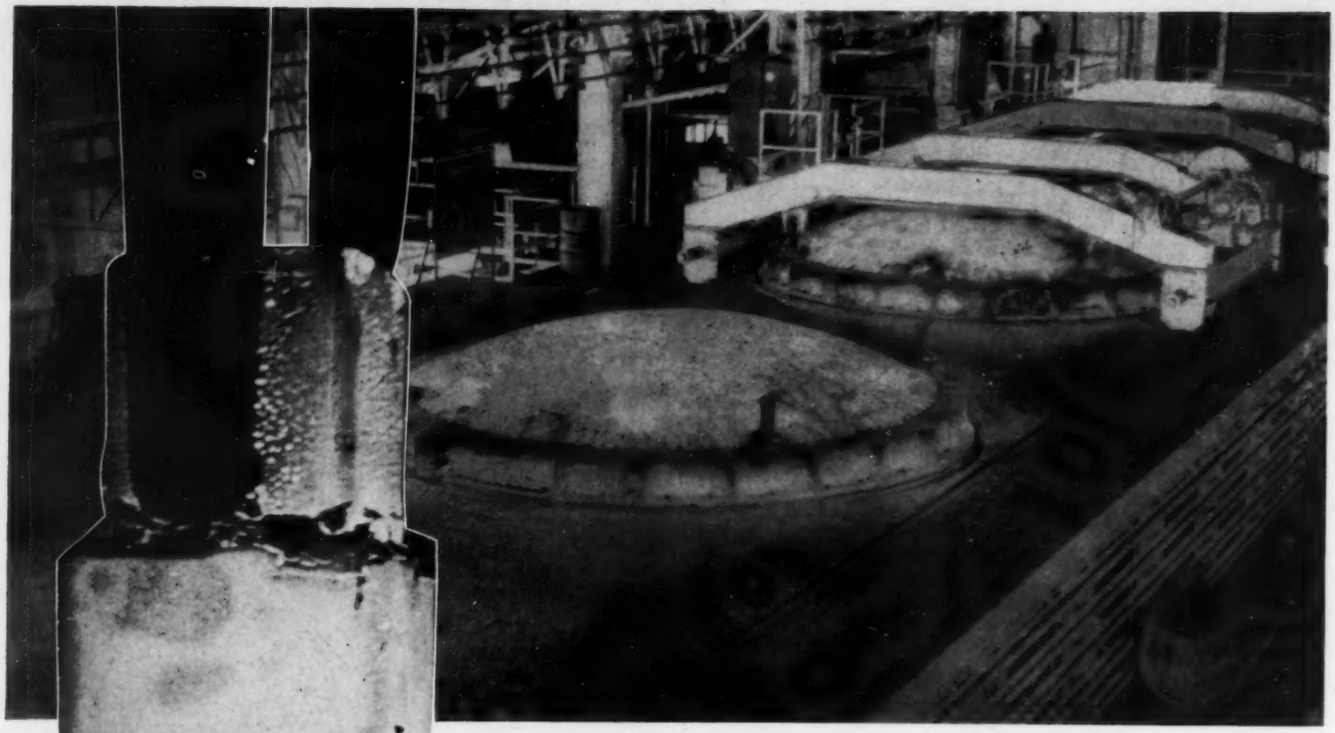
* * *

If you are interested in obtaining further information, please address: Technical Sales Division, Air Reduction, 60 East 42nd Street, New York 17, N. Y.

AIRCO **AIR REDUCTION**

Offices in All Principal Cities

Originators of Modern Oxyacetylene Flame and Electric Arc Methods for ALL Industry



Here's an absolutely unretouched photo—observe the results.

THE SALEM CIRCULAR SOAKING PIT

Offers the maximum operating economy by the effective use of temperature control and combustion control. The temperature control on the circular pit is so placed that it reads actual pit temperature thus making possible very high firing rates without the inherent danger of overheating the pit or metal. At these high firing rates it is necessary to maintain very accurate combustion control as a measure of fuel economy and for proper pit atmosphere as a control of the ingots scaling rate and surface conditioning. Further economy may be gained by the addition of recuperation.

SALEM ENGINEERING CO. · SALEM, OHIO
SOUTHWEST OFFICE · FORT WORTH, TEXAS
SALEM ENGINEERING CO., (Canada) Ltd., TORONTO
SALEM ENGINEERING CO., Ltd., SHEFFIELD, ENGLAND

SALEM

ALL OFFICES STAFFED FOR . ENGINEERING, CONSTRUCTION and OPERATION

Salem Builds

CIRCULAR SOAKING PITS
ROTARY HEARTH FURNACES
CONTINUOUS BUTT-WELD FURNACES
CAR BOTTOM FURNACES
FORGE FURNACES
HEAT TREATING FURNACES
NEEDLE METALLIC RECUPERATORS
AIR RECIRCULATING FURNACES
GAS ATMOSPHERE FURNACES
MECHANICAL EQUIPMENT FOR CHARGING AND DISCHARGING MATERIAL FROM FURNACES

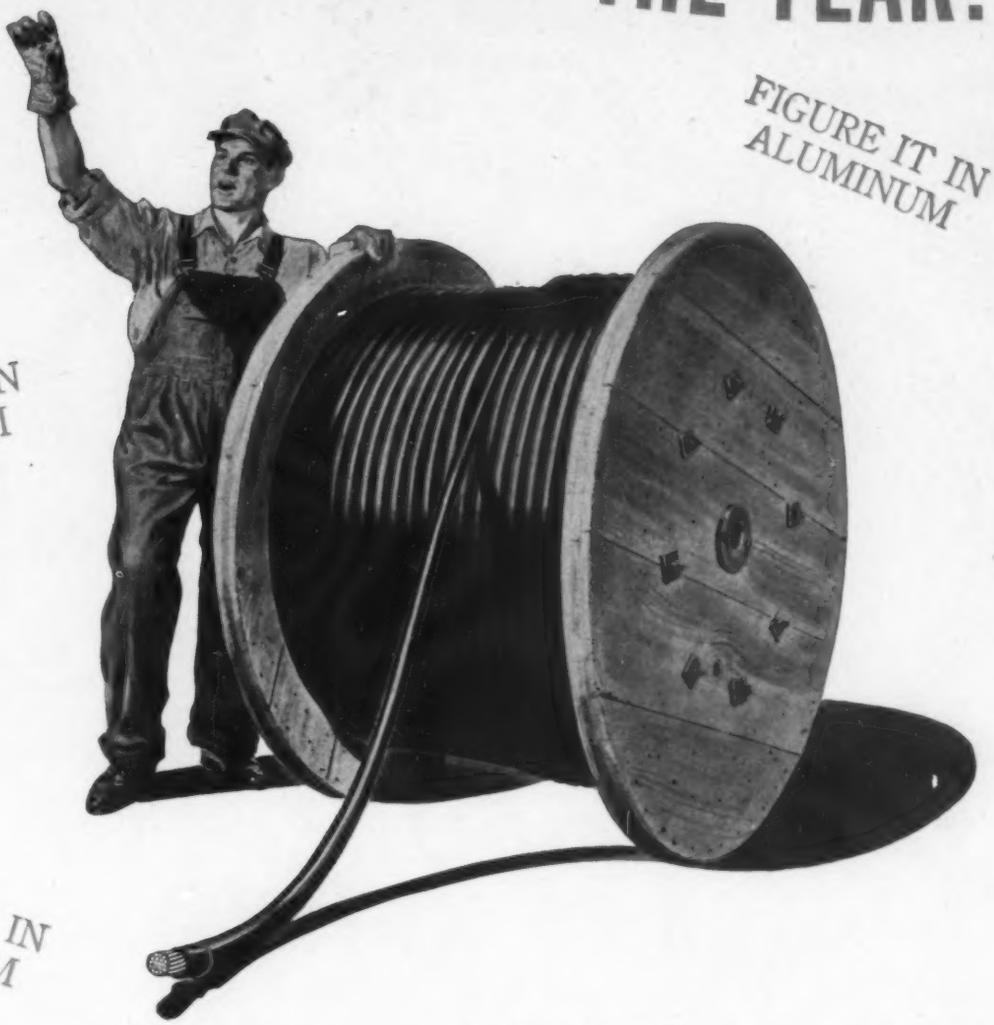
IT'S THE ELECTRICAL

NEWS OF THE YEAR!

FIGURE IT IN ALUMINUM

FIGURE IT IN ALUMINUM

FIGURE IT IN ALUMINUM



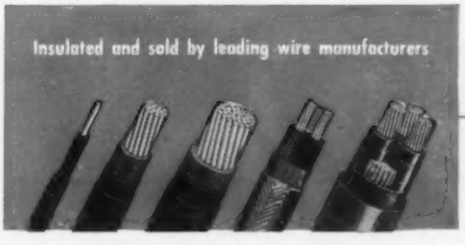
ALUMINUM CUTS WIRING COSTS!

Every construction or modernization job in your plant calls for electric wire and cable. This "buy-word" in wire and cable brings good news—*figure it in aluminum*, for lower over-all job costs!

Figure it in aluminum—to save money. *Figure it in aluminum* because it gives you everything you want in a conductor. Wire and cable manufacturers are drawing, stranding and insulating millions of feet of it—already calling it "the conductor of the present and future". *Figure it in aluminum* because wholesalers are selling this wire with confidence; plant engineers and contractors are installing it with assurance of dependability.

To make available the light, dependable, conductive E. C.* Aluminum for this service is Alcoa's job. Wire and cable manufacturers make the finished product, selling it under their trademarks. It will pay you dividends, now and in the future, to *figure it in aluminum*. ALUMINUM COMPANY OF AMERICA, 2128 Gulf Building, Pittsburgh 19, Pa. Sales offices in principal cities.

* E. C.: Electrical Conductor Aluminum



ALCOA EC ALUMINUM

FOR ELECTRIC WIRE AND CABLE

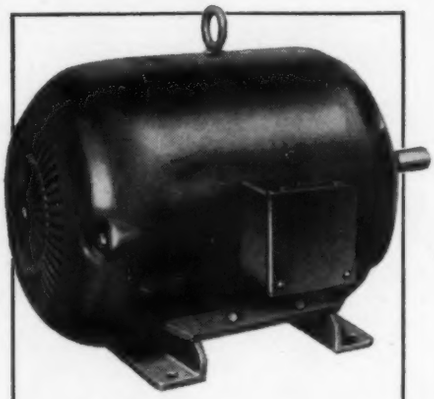
DUST and DIRT CAN'T HURT WAGNER *cp* MOTORS*

**Totally-Enclosed Fan-Cooled Motors are SEALED against Harm . . .*

THEY'RE built to take it . . . They're protected against dust, dirt, grit, steel chips, abrasives, and other destructive elements that would tear the heart out of ordinary motors. That's why you find thousands of Wagner totally-enclosed fan-cooled motors giving dependable service day after day, year after year, doing the dirty jobs in industry without asking favors.

If you use motors, it will pay you to investigate Wagner—A complete line . . . built by engineers who know how to build quality motors that will help you maintain peak production. Users of Wagner motors also profit by our quick, convenient, nationwide service facilities.

Contact any of our twenty-nine branch offices, located in principal cities and manned by trained field engineers ready to give you advice on all of your motor problems. Bulletins on the complete line of quality motors will be sent upon request. Address Wagner Electric Corporation, 6483 Plymouth Avenue, St. Louis 14, Mo.

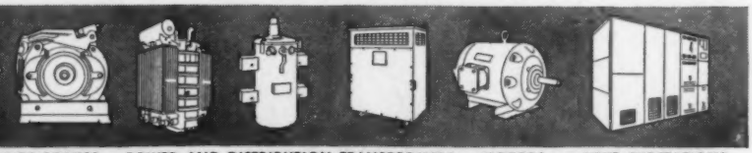


Pictured above is a Wagner totally-enclosed fan-cooled motor. Wagner makes a complete range of motors for every application.

M47-8

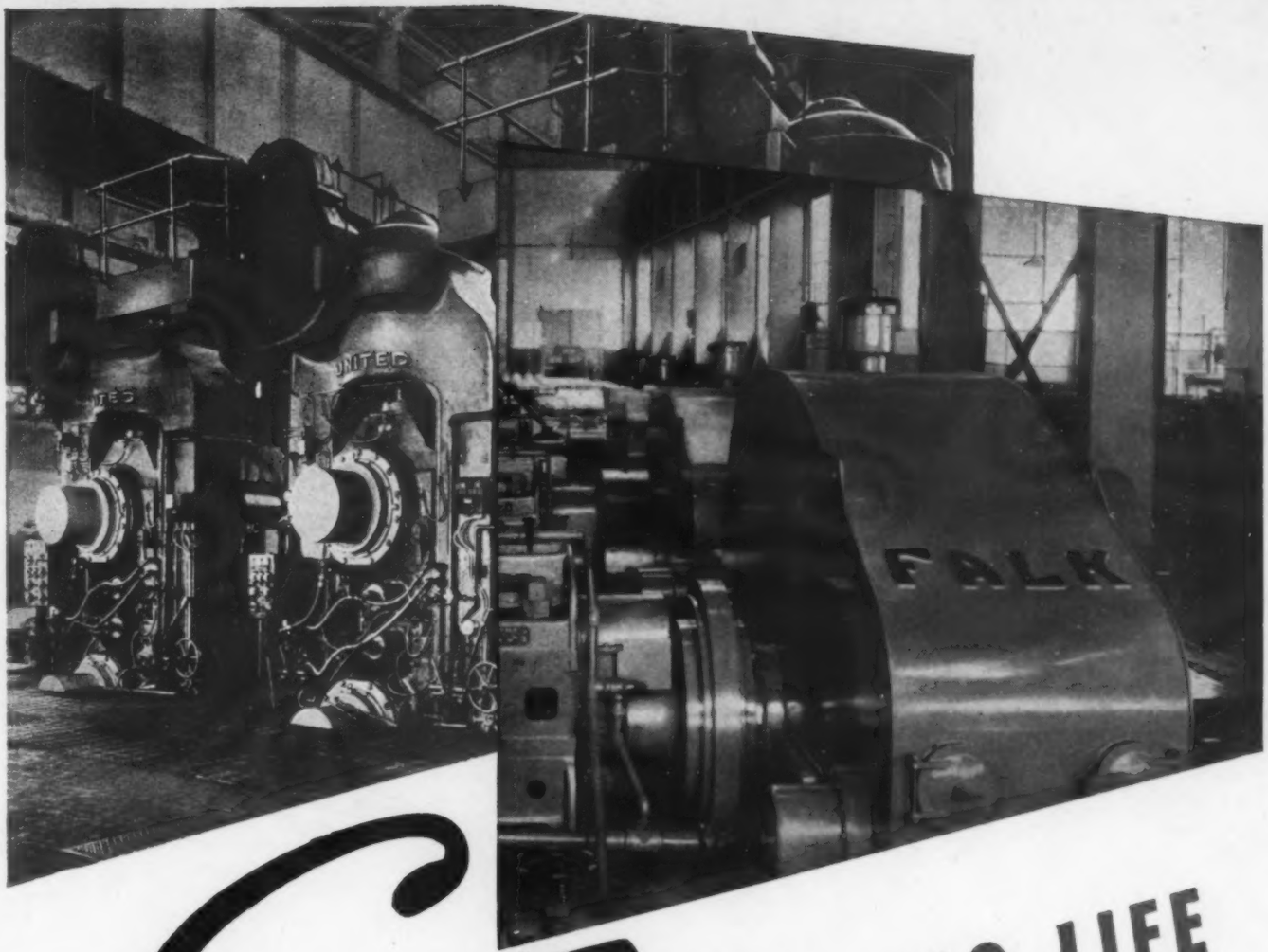
Wagner Electric Corporation
EST. WE 1891

Consult Wagner Engineers on all Electric Motor Problems



BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL AND AUTOMOTIVE PRODUCTS



Extra LONG LIFE FOR GEARS

PROTECT your reduction gear drives with *Texaco Meropa Lubricants,* and they'll operate more efficiently, require less servicing, give you *extra* long service life.

There are *Texaco Meropa Lubricants* for every type, size and speed of enclosed drive — including heavy-duty worm gears. They have exceptionally high load-carrying capacity, resist oxidation and thickening, have strong adhesive qualities, and do not foam.

Texaco Meropa Lubricants also prevent bearing corrosion, and do not separate in service, storage or centrifuging.

To keep high-speed strip mills operating dependably, keep circulating systems *clean* with *Texaco Regal Oils.* These turbine-grade, heavy-duty circulating oils resist sludge formation — so prevent costly stoppages.

For Texaco Products and Lubrication Engineering Service, call the nearest of the more than 2500 Texaco distributing plants in the 48 States, or write The Texas Company, 135 E. 42nd St., New York 17, N. Y.

TEXACO

TEXACO Meropa Lubricants

FOR STEEL MILL REDUCTION GEARS

Tune in . . . TEXACO STAR THEATRE presents the TONY MARTIN SHOW every Sunday night. See newspaper for time and station.

Automatically self-adjusting . . .

because of the use of spherical rollers turning in an outer race which is a section of a true sphere, the Spherical Roller Bearing adapts itself freely and easily

To misalignment or deflection.

This feature assures dependable operation of the bearing since the total area of bearing contact surface is maintained under all conditions. It eliminates undue wear and premature bearing failure which ordinarily result from uneven stresses set up by misalignment.

The high radial capacity, two-directional thrust capacity, unit construction and self-aligning features of the Spherical Roller Bearing may solve *your* friction problem. For further information, write for Bulletin No. 200-A.

THE TORRINGTON COMPANY

SOUTH BEND 21, IND. TORRINGTON, CONN.

Offices in All Principal Cities

TORRINGTON BEARINGS

• NEEDLE • SPHERICAL ROLLER • STRAIGHT ROLLER • TAPERED ROLLER • BALL •

ENGINEERED SIMPLICITY

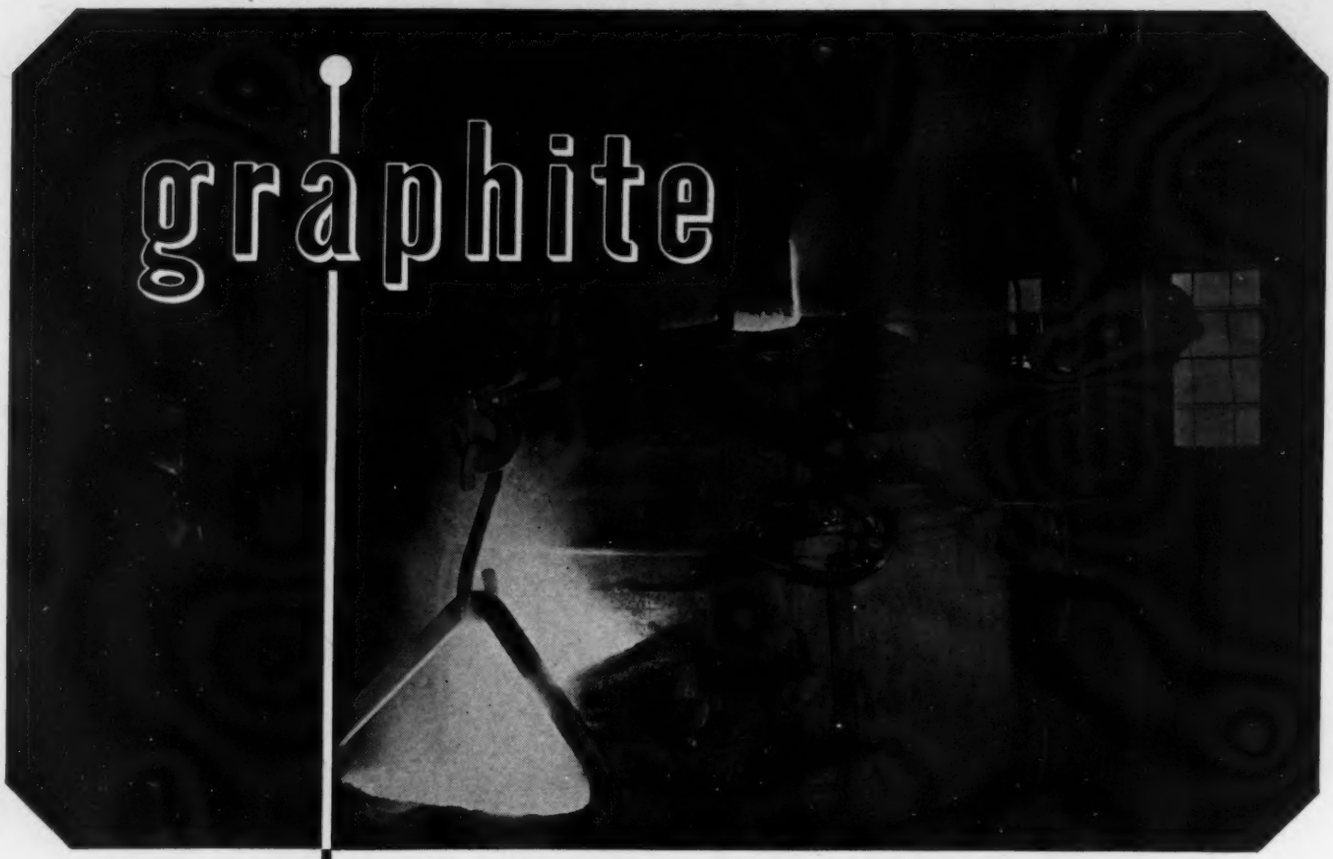
This 60-inch, Three-High Mill is typical of all Lewis equipment . . . extremely simple in design, extra sturdy in construction. Result — ease of operation, economy of maintenance, greater profits for the owners.

For an interesting picture of Lewis Products and Services write for Bulletin No. 2040.

LEWIS ROLLING MILL EQUIPMENT

Also Manufacturers of ROLLS AND ROLLING MILL MACHINERY FOR THE IRON, STEEL AND NON-FERROUS INDUSTRIES

LEWIS FOUNDRY & MACHINE • Division of Blaw-Knox Company • Pittsburgh, Pa., U. S. A.



simplifies foundry problems

A UNIQUE COMBINATION of physical properties in graphite make it a superior material for many applications in casting, molding and heat treating ferrous and non-ferrous metals. Molds, plugs, sintering boats and trays, riser rods, stool inserts, crucibles and chill blocks made of graphite have demonstrated these outstanding advantages: High resistance to thermal shock, thereby eliminating spalling, cracking and inclusions . . . negligible thermal expansion with consequent retention of original shape and dimensions at highest temperatures involved in foundry operations . . . freedom from sticking and slagging because molten metal does not wet graphite; quick cooling due to high heat-transfer qualities; light weight and low cost.

Perhaps these exclusive advantages of graphite are the practical solution to some of your steelmaking and foundry problems. The International technical staff will be glad to assist you in adapting this versatile material to your operations. International supplies graphite in blocks, tubes and slabs, or machined to your blueprint specifications.

Other International Graphite Products

Electrodes—for electrothermic and electrolytic purposes

Rods—for open, blind, and semi-blind risers

Mold Plugs—for ingot molds

Granular Graphite

Graphite Specialties

1591

ICE

International Graphite & Electrode Corp.

SAINT MARYS, PA.

Material Handling at First U. S. Tin Plant

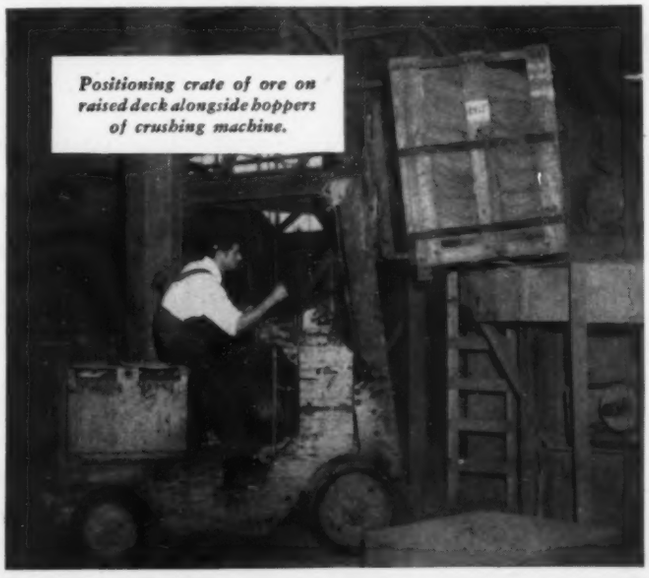
—built around BAKER TRUCKS

"After four years operation Baker Fork Trucks continue satisfactory . . . in our Texas City Plant"
— Tin Processing Corporation

Baker Fork Truck removing pallet-type crates of bagged ore from flat car.

● The continuous operation of the Tin Processing Corporation's Texas City plant—largest tin smelter in the Western Hemisphere—built to meet our war requirements—depends on the durable and reliable service of a fleet of Baker Trucks.

Ore arrives by vessel in 100 lb. bags, which are palletized at the wharf and loaded by a Baker Fork Truck onto flat cars, for transportation to the plant. Here another truck unloads and stores the pallet type crates.



Positioning crate of ore on raised deck alongside hoppers of crushing machine.

As ore is needed, a fork truck carries a crate to the mixing hopper, placing it on a raised deck, from which bags are emptied into the hopper. After crushing and purification, ores go to the smelter for reduction to metal and casting into bars. Stacks of bars weighing 4,000 lbs. are carried by truck to storage and later to box cars for shipment.

Besides Baker Fork Trucks, the plant uses a Baker Hopper Truck with built-in scale for measuring batches going to smelting furnaces.

Management and maintenance men are enthusiastic about the trucks—particularly because of their excellent service under the difficult operating conditions caused by the relatively fine and gritty nature of the ore handled.

Let a Baker Material Handling Engineer show you how to improve your production efficiency.

BAKER INDUSTRIAL TRUCK DIVISION
of The Baker-Raulang Company
2166 West 25th Street • Cleveland 13, Ohio
In Canada: Railway & Power Engineering Corp., Ltd

EITA

Member: Electric Industrial Truck Association

2700-1B-47

Baker INDUSTRIAL TRUCKS

RELIANCE MOTORS

PRODUCE WHERE PRESSURES ARE TERRIFIC!

Bars and tubes give under the terrific pressure, but there's no interruption in the dependable performance of Reliance Heavy Duty D-c. Motors which power straighteners.

Where pressures are severest in processing iron and steel, Reliance Heavy Duty D-c. Motors are right in their element! Designed and built, electrically and mechanically, to stand up longer in the toughest going, these rugged motors offer the maximum in dependability and economy. There is a type to satisfy the power requirements of every job where operating conditions demand a heavy duty motor. Call your nearest Reliance Sales Representative!

Reliance Heavy Duty Type T Motor

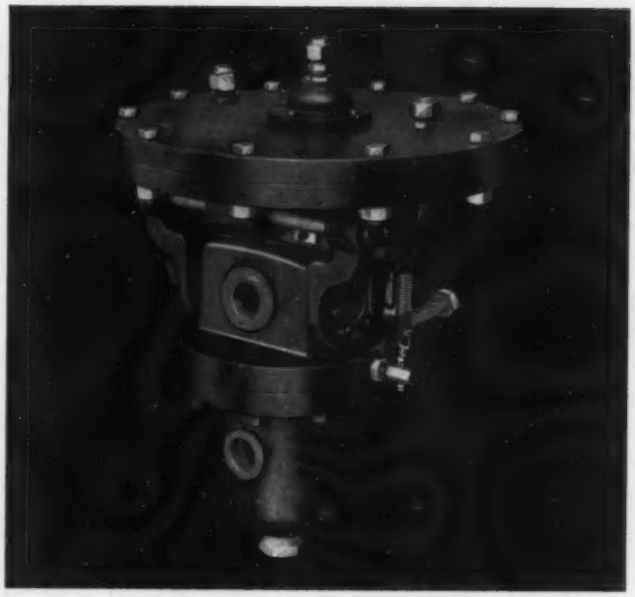
RELIANCE ELECTRIC & ENGINEERING CO.

1084 Ivanhoe Road **Cleveland 10, Ohio**

Appleton, Wis. • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Dallas • Denver • Detroit • Gary
Grand Rapids • Greenville, S. C. • Houston • Kansas City • Knoxville • Los Angeles • Milwaukee • Minneapolis
New Orleans • New York • Philadelphia • Pittsburgh • Portland, Ore. • Roanoke, Va. • Rockford
St. Louis • San Francisco • Seattle • Syracuse • Tampa • Tulsa • Washington, D. C. • Sao Paulo, Brazil

RELIANCE A-C D-C MOTORS

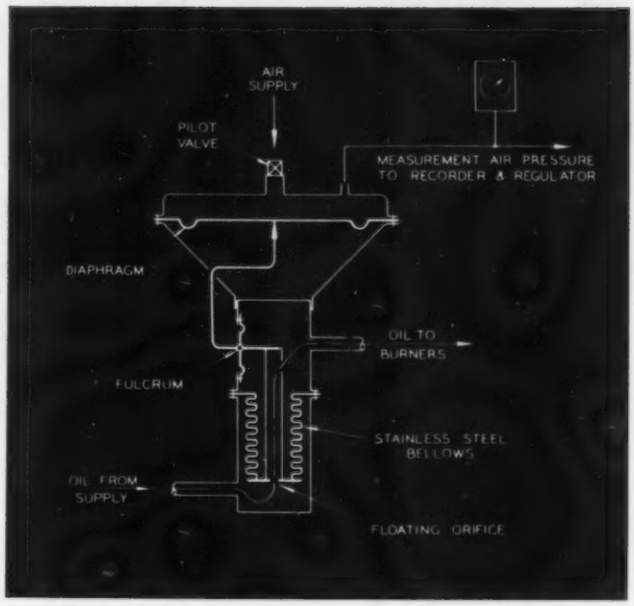
From gas to oil in a hurry



. . . with Hagan Differential Transformers

Winter shut-downs because of inadequate gas supply are expensive, which is why steel companies now demand heating furnaces which can burn either gas or liquid fuel.

Controls by Hagan mean that the shift from one fuel to the other can be made quickly—with practically no interruption of production—without the need of any servicing or readjustment of equipment.



The key to this performance is the Hagan Differential Transformer. In the Hagan Differential Transformer, all oil to be measured passes through the Transformer, thus eliminating feeler lines. Viscosity effects are reduced to a minimum by a properly-designed floating orifice. There are no closely-fitting moving surfaces, hence dirt and grit do not affect accuracy.

Hagan Oil Transformers may be used with either Hagan Control or with other types of control; they may be used in new installations or as replacements for other types of oil flow measuring elements. Our engineers will be glad to give you full information.

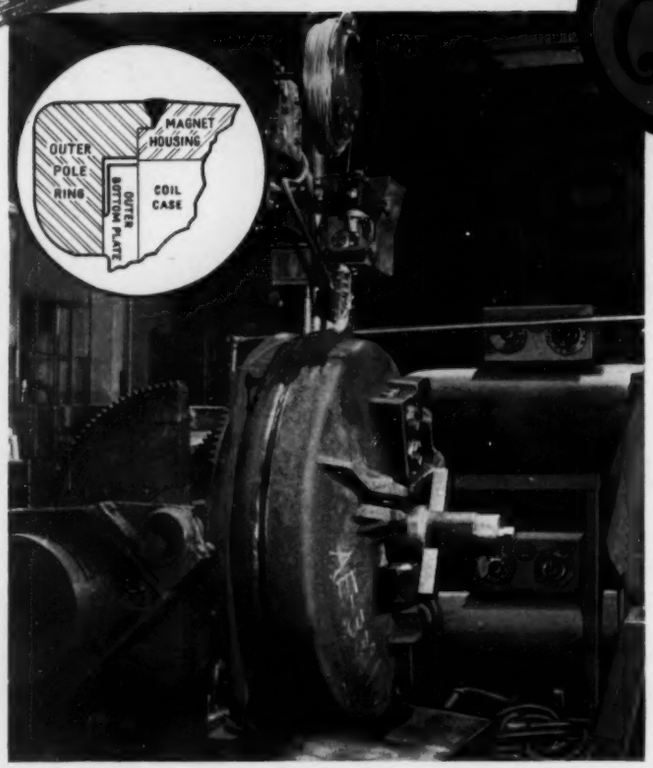
Hagan Corporation, Hagan Building, Pittsburgh 30, Pennsylvania.

HAGAN CORPORATION

HAGAN
HALL
BUROMIN
CALGON

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

Pole Shoes AUTOMATICALLY WELDED on EC&M Type SW ALL-WELDED MAGNETS



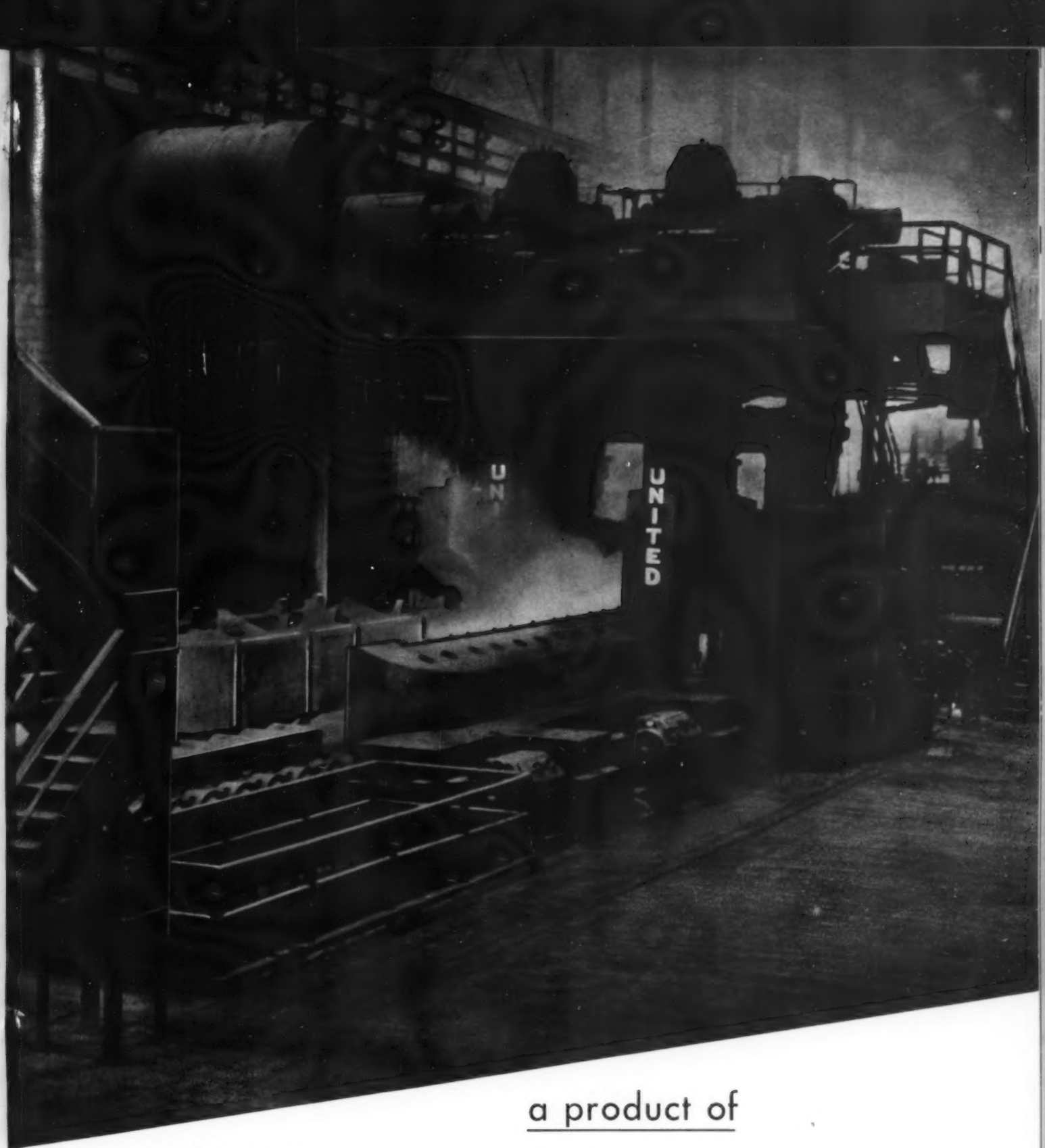
● Made by an automatic welding-head as the positioner-table rotates the magnet, the weld between outer pole shoe and magnet-housing is *strong, homogeneous,* and *ductile.* Furthermore, it is permanent and assures continuous high-lifting capacity.

Welding eliminates bolts that stretch, allowing rust, scale, and other foreign material to enter crevices, often making snug re-fit of pole shoes impossible; no recesses for bolt heads to interrupt the magnetic path. In these *all-welded* magnets, outer pole shoes and center shoe plates are permanently mated to magnet-housing by welding.

As proof of the superior lifting capacity of this advanced magnet-design, examine the installation views at right. These are busy, scrap-handling scenes. Note how the lifts completely fill the face of the magnet. Loose pieces also cling to the magnet-sides.

For complete description of this outstanding EC&M Type SW *All-Welded* Lifting Magnet, write for your copy of Bulletin 900.

THE ELECTRIC CONTROLLER & MANUFACTURING CO.



45 inch Reversing Slabbing Mill which recently broke all world's records by producing 159,792 tons of steel slabs in one month.

a product of

UNITED

ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PA.

DESIGNERS AND MAKERS OF ROLLS AND ROLLING MILL EQUIPMENT

PLANTS AT PITTSBURGH · VANDERGRIFT · NEW CASTLE · YOUNGSTOWN · CANTON

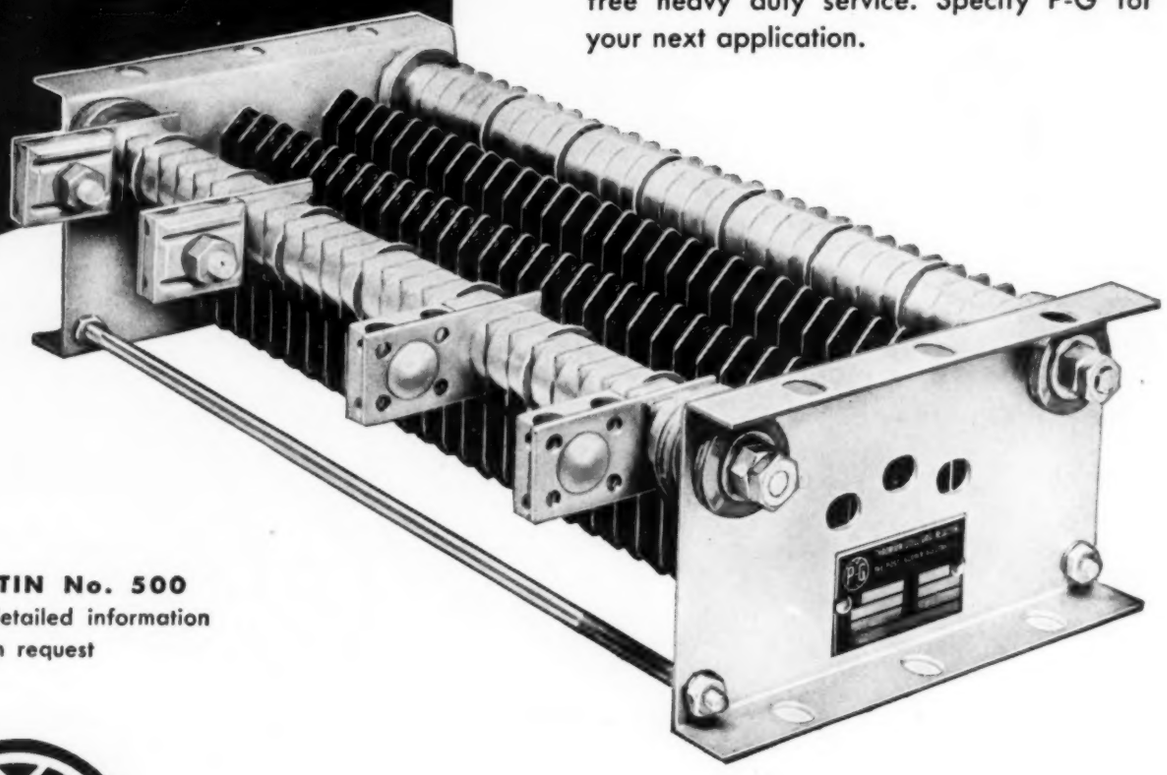
MEET *All* REQUIREMENTS

... *correct* OHMIC VALUES

... *plus* AMPLE CAPACITY

P-G *Steel Grid Resistors*

Use resistance grids punched from many gages of resistor steel. Thus it is easier for P-G to meet correct ohmic values and still furnish the capacities necessary for each job. Ability to meet both requirements is assurance of accurate control with full protection for your electrical equipment. All steel construction, mica insulation, with provision for expansion and ample ventilation give that extra stamina needed for trouble-free heavy duty service. Specify P-G for your next application.



BULLETIN No. 500
Gives detailed information
Copy on request

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

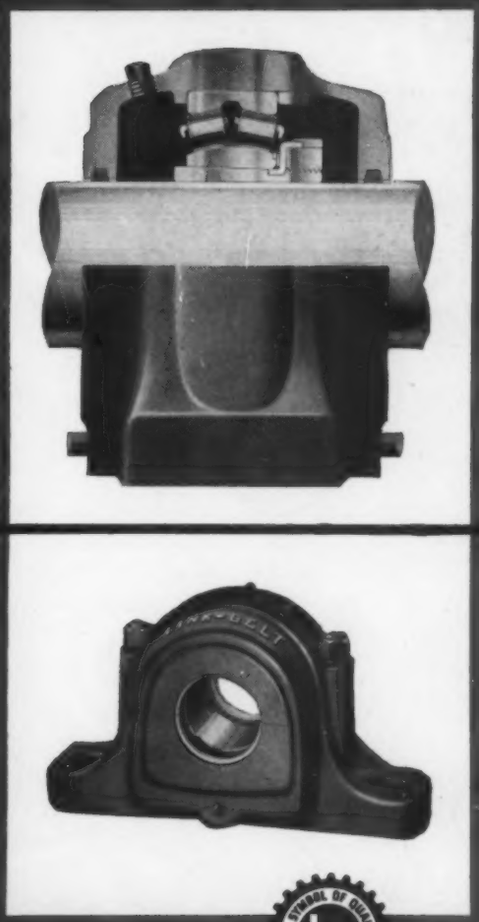
• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

TO SUGGEST

installation of ball or roller bearings as replacement for plain bearings is merely to tell you something you most likely accept as logical. To suggest *Link-Belt* Ball or Roller Bearings is to tell you that the line is so complete that the replacement can be made whatever the need. To suggest that you can specify practically any replacement (from listings in Books 2094 and 2095 sent immediately upon request) by calling your local Link-Belt distributer is to call attention to the service available to you.

1. Heavy series precision-built double row self-aligning roller bearings.
2. Tapered sleeve securely mounts inner race on commercial grades of cold-finished shafting.
3. Lock nut clamps assembly securely to shaft and is prevented from loosening by serrated lock washer.
4. Felt seals for grease lubrication or "Spiro-Seals" for oil or grease lubrication.
5. True flat surfaces assured for nut pressure surface.
6. Housings drilled and tapped for drain plugs on both sides.
7. Casting spotted for dowel hole to locate unit on support. Slotted holes for foundation bolts.
8. Sturdy, compact, split housing provides convenience in mounting, lubrication and disassembly.
9. Tapped holes in cap take standard screw to raise cap off base without damage to finished surface.
10. Permits different methods of lubrication, such as grease, constant oil level or circulating oil.
11. Bearings can be either fixed or floated axially. "C" spacers may be removed or inserted as required.



LINK-BELT

BALL AND ROLLER BEARINGS

LINK-BELT COMPANY • Chicago 9 • Indianapolis 6 • Philadelphia 40 • Atlanta • Dallas 1 • Minneapolis 5
San Francisco 24 • Los Angeles 33 • Seattle 4 • Toronto 8 • Offices, Factory Branch Stores and Distributors in Principal Cities

"Just like adding a New Furnace"

WHAT A COMPLETE INSTALLATION OF B&W REFRACTORIES DID FOR THIS PLANT

	STANDARD FIREBRICK LINING	B & W LINING	CHANGE
Heats per Month	21	41	+ 95%
Gallons oil per Heat	194.7	143.5	— 26%

Furnace relined with B&W Insulating Firebrick: Sidewalls and end—9" B&W K-26 I.F.B. backed with 4½" B&W K-16 I.F.B.; Arch—9" B&W K-26 I.F.B. backed with 2½" B&W K-16 I.F.B. Car lined with 8" B&W K-22 Insulating Concrete, topped with B&W Junior Firebrick.

"Just like adding a new furnace," was the operator's comment when he saw the improvement in production and fuel efficiency obtained by relining his furnace with B&W Refractories.

From 1942, when Pelton Steel Castings Co. built this furnace, various combinations of refractories were used without success. Standard firebrick failed and required frequent repairs.

But . . . early in 1946, the furnace was completely relined with B&W Refractories. Since then, maintenance has been negligible. And—as the above production record shows—*production has practically doubled,* while fuel consumption per heat is substantially lower.

This is just one of many typical case histories that demonstrate how B&W Refractories are increasing production and reducing costs in all types of industries.

R-292

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

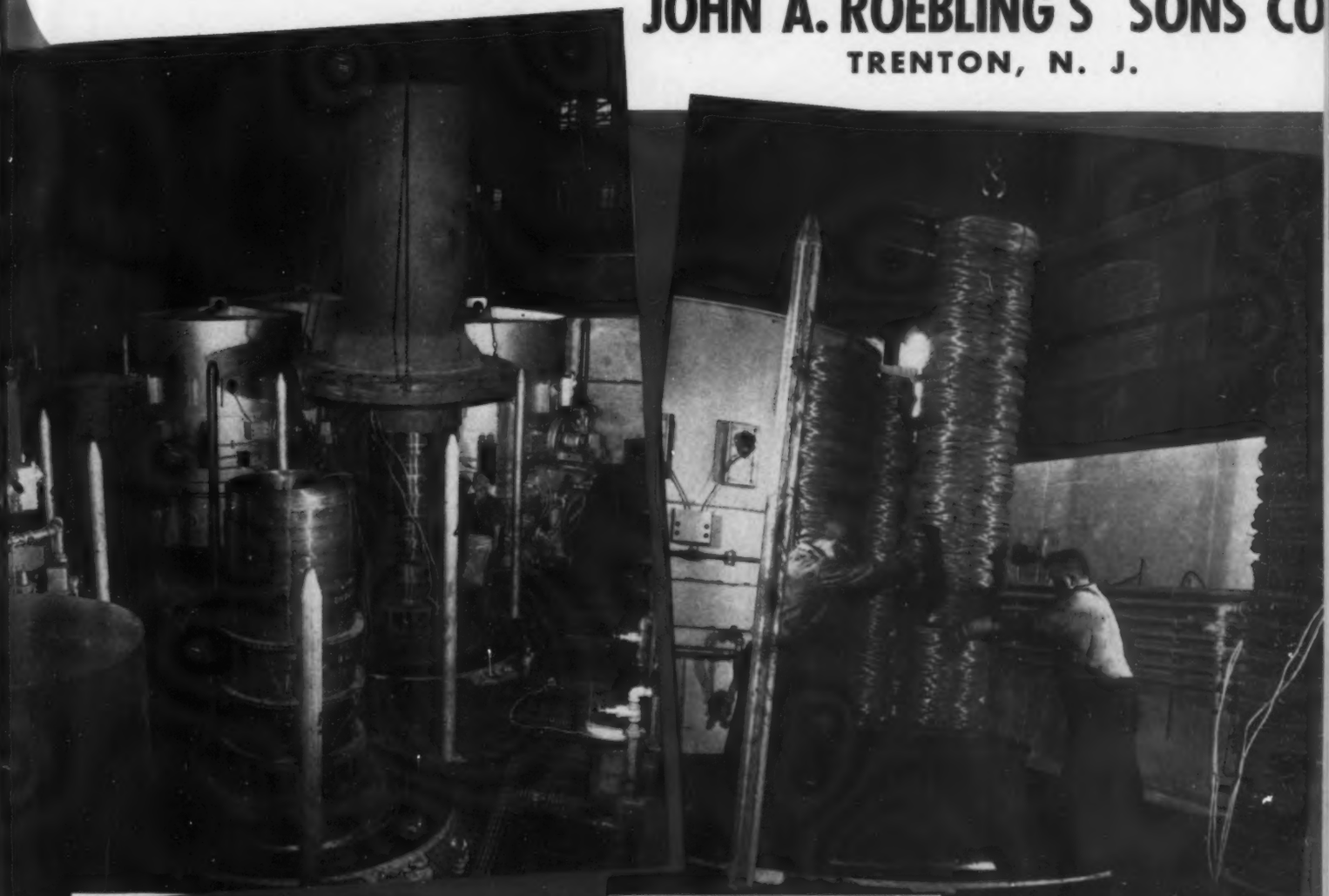
BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 85 LIBERTY ST, NEW YORK 6, N.Y.
WORKS: AUGUSTA, GA.

This is a new **WILSON** Annealing Installation for High Carbon Strip and Wire Coils at the

JOHN A. ROEBLING'S SONS CO

TRENTON, N. J.



The Wilson Annealing Unit is covered by Patents Nos. 1,952,402, 2,068,417, 2,078,356, 2,081,612, 2,089,843, and other patents pending.

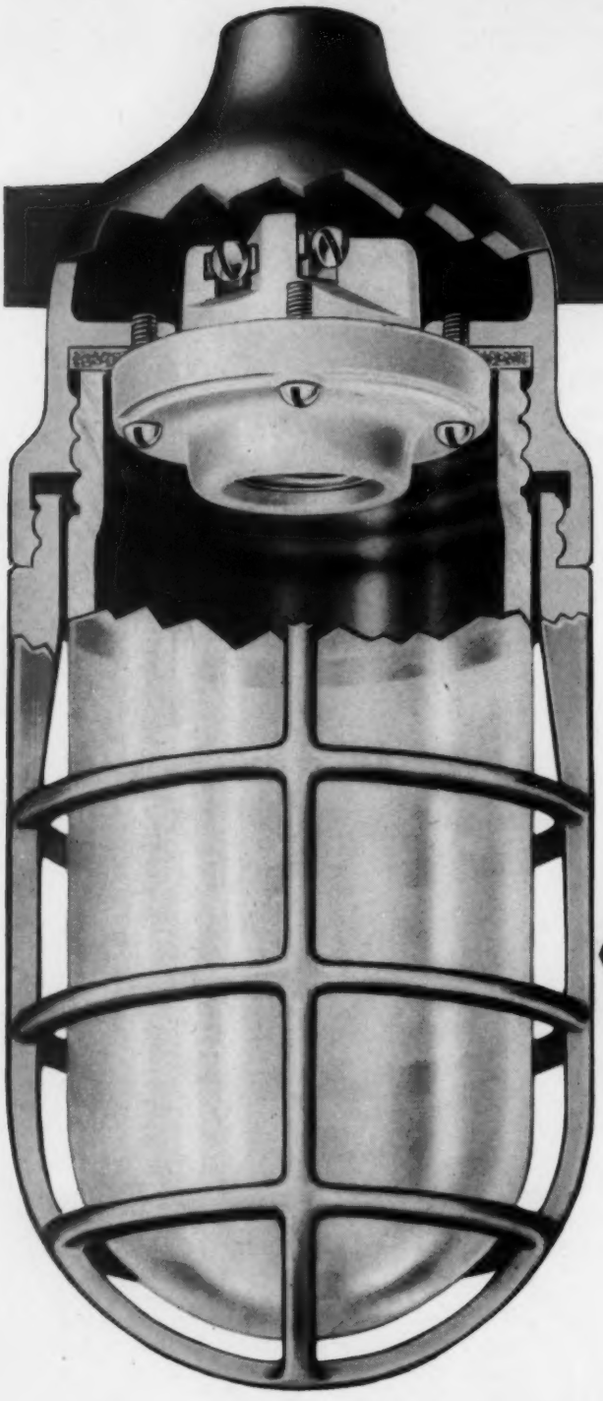
ENGINEERED AND CONSTRUCTED BY

Lee Wilson

ENGINEERING CO., INC.

CLEVELAND, OHIO

INDUSTRIAL FURNACES • RADIANT TUBE HEATING • HEAT TREATING PROCESSES



Vaportight
Industrial Lighting
CONDULETS

(CONDULETS are made only by CROUSE-HINDS)

For boiler rooms, shower rooms, powerhouses, tunnels, docks, building entrances, and all indoor or outdoor locations where exposed to non-explosive vapors and gases or moisture and rain. Also for use where exposed to non-combustible dusts.

Vaportight and raintight.

Wiring chamber remains vaportight even though globe is off.

Screw guard or clamp guard types.

12 Hub arrangements.

4 Reflector styles.

Accessories: colored globes, guards, half shades, adapters.

4 Sizes: 50 through 500-Watt.

Other ***Vaportight*** lighting fixtures are available for attachment to many round-base Condulets and sheet steel outlet boxes. Crouse-Hinds complete ***Vaportight*** line includes hand lamps, switches, plug receptacles, and other electrical devices.

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY
Syracuse 1, N. Y., U.S.A.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — Washington. *Resident Representatives:* Albany — Atlanta — Charlotte — Indianapolis — New Orleans
CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

NOW READY! AUTOMATIC'S NEW

Skylift GIANTS

WORLD'S LARGEST TRACTORS
Handle 10 to 30 Tons!

SPECIALLY ENGINEERED TO KEEP HANDLING METHODS ABREAST OF STEEL AND HEAVY INDUSTRY OPERATIONS

Completely new in design, these mammoth material handling giants contain features never before offered in heavy-duty fork and ram tractors.

4-wheel front drive assembly, with twin drive units, each equipped with two 36 inch diameter tires, provide as much as 80 inches of rubber on traction wheels—dual controls enable driver to operate from center position as well as both sides of tractor. Pivoted drive axles provide constant 4-wheel traction regardless of floor conditions—controlled caster type trail axle, center-pivoted, compensates for uneven surfaces.

SKYLIFT GIANTS are approximately 20% lighter in proportion to load capacity than previous heavy-duty fork and ram tractors. They are the first and only heavy-duty industrial trucks with high pressure hydraulic lift of original design which eliminates chains, sprockets and other forms of lift multiplication. Mail coupon for facts.

Look to the Leader for All That's New!

Skylift GIANT

AUTOMATIC TRANSPORTATION COMPANY
DIV. OF THE YALE & TOWNE MFG. CO.

47 West 87th Street, Dept. T-7, Chicago 20, Ill.
( ) Send details on Automatic's NEW SKYLIFT GIANT Fork and Ram Tractors.

Company Name.....

By.....

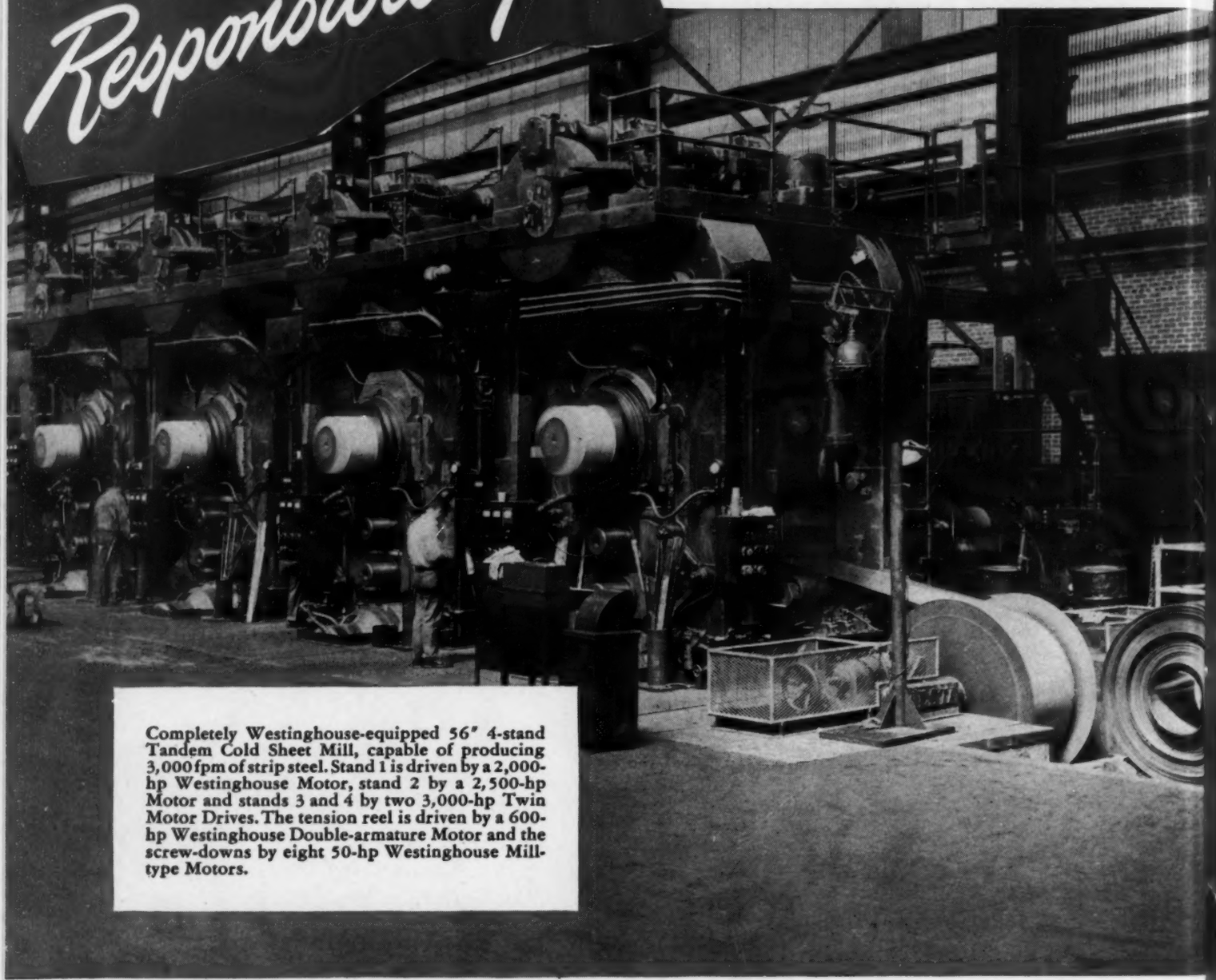
Street Address.....

City.....*Zone*.....*State*.....

MANUFACTURERS OF THE FAMOUS TRANSPORTERS, TRANSTACKERS, AND SKYLIFT ELECTRIC TRUCKS

Unit Responsibility

KEY TO MORE



Completely Westinghouse-equipped 56″ 4-stand Tandem Cold Sheet Mill, capable of producing 3,000 fpm of strip steel. Stand 1 is driven by a 2,000-hp Westinghouse Motor, stand 2 by a 2,500-hp Motor and stands 3 and 4 by two 3,000-hp Twin Motor Drives. The tension reel is driven by a 600-hp Westinghouse Double-armature Motor and the screw-downs by eight 50-hp Westinghouse Mill-type Motors.

FROM PLANNING BOARD TO PRODUCTION . . .
YOUR BEST ANSWER TO ALL OF YOUR ELECTRICAL AND POWER PROBLEMS

The high production rate of today's steel mills is a story of continuous development in methods and machines. The trend is toward a higher degree of electrification very necessary for flexible power and accurate control.

In this development program, Westinghouse has been responsible for an impressive list of important contributions to the steel industry, worked out in co-operation with steel mill engineers.

For this reason, Westinghouse today is regarded as an operating partner of the steel industry, offering engineering "know-how" and a single source for apparatus—for every electrical or power problem. The result is the highest degree of co-ordinated electrification.

For help in working out your problems—for the best in drive, control and lighting equipment—call on Westinghouse. It's your soundest assurance of maximum performance and dependability. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-94769

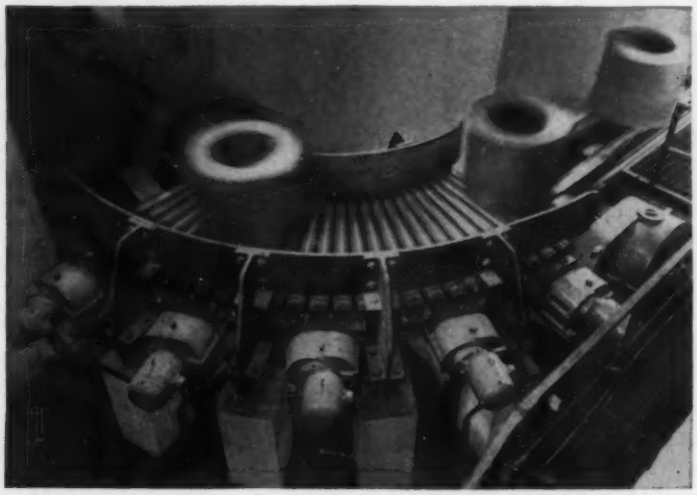
PRODUCTIVE POWER

"WESTINGHOUSE-EQUIPPED THROUGHOUT" MEANS SIMPLIFIED ORDERING, QUICKER INSTALLATION, MORE EFFICIENT OPERATION

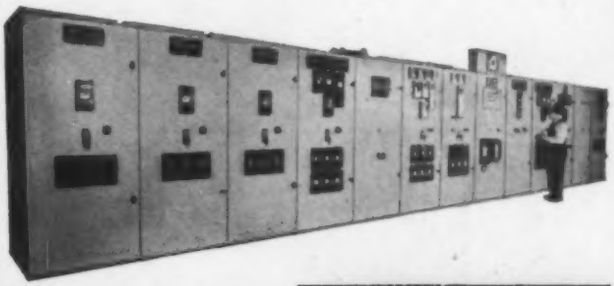
Putting power to work *productively* can be a major problem . . . or a simple one. When items must be selected, ordered and received from many sources, it means many chances for costly errors and delays . . . divided responsibility for performance of installed equipment.

Westinghouse offers the way to simplify the job. From equipment for generation of electrical or steam power, to the most specialized types of drives, gearing and control for its utilization, Westinghouse provides a single source of supply . . . competent to take responsibility for performance of all parts of the job.

A typical example of Westinghouse unit responsibility is the installation of a 56" Tandem Cold Mill—illustrated on these pages. This is one of today's most modern mills. It is completely Westinghouse-equipped, and is Rototrol-regulated for fully automatic control of speed and tension.



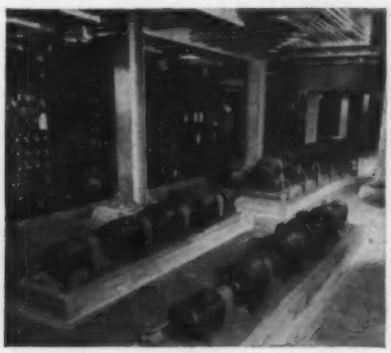
COIL CONVEYOR system between hot mills and tandem cold mill. The tapered rolls comprising the 90° bend are synchronized with the conveyors by use of variable frequency drives. Eleven 35-hp Westinghouse Mill Motors drive about 1,000 feet of conveyor. Five 1-hp Westinghouse Gearmotors drive the 90° bend.



SWITCHGEAR — 6,600-volt Westinghouse Metal-clad Switchgear for entire cold mill. Includes high-voltage, a-c circuits for tandem mill, skin-pass mill and 7 Power Centers.

AIR CLEANING—108,000 cfm Westinghouse Precipitron, for cleaning the air from the 8,000-kw synchronous m-g set, prior to recirculating the air into the motor room.

MOTOR ROOM of tandem sheet mill. On the left are Westinghouse Main Roll Drive Motors. In the background is an 8,000-kw Westinghouse M-G Set. Exciters, Rototrols and I-R Drop Compensator are in the right foreground.



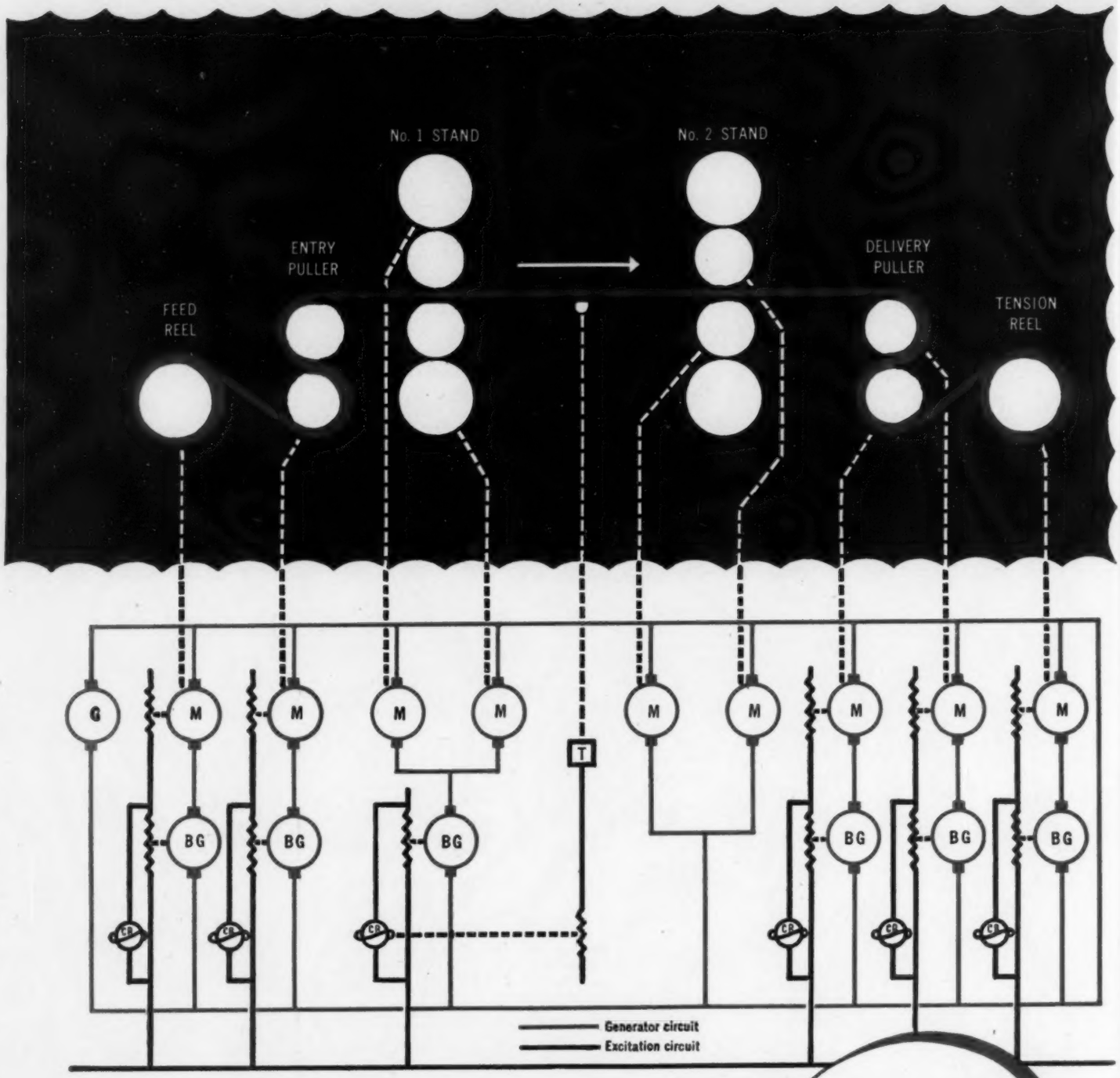
CONTROL panels, exciters and Rototrols for two single-stand, skin-pass mills. Here complex control problem is simplified by systematic location of many conduits.

RECTIFICATION — This 1,000-kw Westinghouse Ignitron Rectifier provides d-c power for auxiliaries requiring constant voltage.

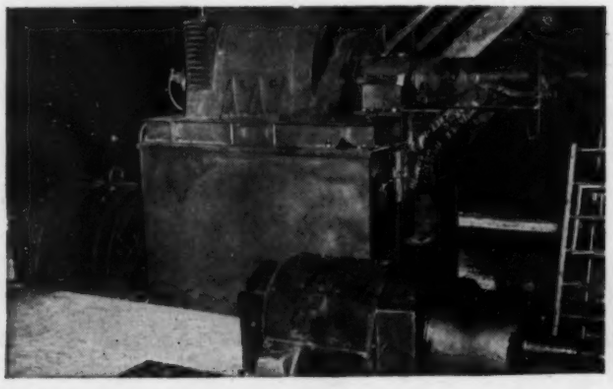
Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

MORE PRODUCTIVE POWER FOR INDUSTRY



Twin motors driving back-up rolls on stand No. 1, and drag generator on entry-puller



another example of
drive engineering at work!

new "twin-motor" temper mill drive holds tension accurately at 3700 fpm!

engineered drive paves the way for higher rolling speeds and greater production of quality steel

Here is another fine example of General Electric drive engineering and how it can save time and money for steel operators. It is the recently developed twin-motor drive for a two-stand temper mill. It combines all the advantages of twin motors on each stand with an exceptionally accurate method of controlling tension between stands.

Trial tests showed that the new mill can be operated as fast as 3700 feet per minute and still have strip tension between stands within close limits. Key to the success of the new drive is a unique combination of amplidyne control and a high-accuracy General Electric regulating tensiometer. The drive on this new mill also maintains tension accurately between the stands and the pullers as well as between the pullers and reels by use of conventional amplidyne current control.

Specifically, this new General Electric temper-mill drive provides the mill operator with these important advantages:

- *It enables the operator to compensate electrically for unequal roll diameters, thus eliminating the necessity for exactly duplicating work-roll diameters.*
- *It eliminates pinion stands and the expense of maintaining them.*
- *Most important, it reduces inertia, thereby permitting the mill to be accelerated or decelerated more rapidly with accurate control of tension to provide increased production of high-quality steel.*

General Electric amplidyne control performs a number of important functions in this new mill drive. It holds tension accurately throughout acceleration, running, and deceleration. It automatically synchronizes the speed of the winding reel with the strip speed. In addition, amplidyne control has eliminated numerous heavy control contactors, replacing them with small, easy-to-maintain relays.

Because this General Electric drive is engineered and installed as a unit, you are spared the trouble and expense of co-ordinating all the components of modern mill drives—motors, controls, cable and power distribution equipment. General Electric makes sure that every equipment selected is the right one for the job, and assumes responsibility for securing delivery of all the electrical components. Until the drive is installed and running smoothly, a G-E steel-mill specialist's help and experience are freely available. Why not consult the steel-mill specialist in your local General Electric office on your drive problems *now? Apparatus Department, General Electric Co., Schenectady 5, N. Y.*

A QUICK EXPLANATION *of this new mill drive!*

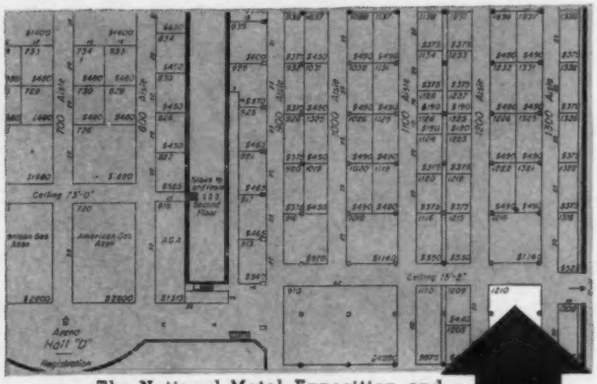
Strip tension between the No. 1 and No. 2 stands of this temper mill is measured by a regulating tensiometer (T). As tension tends to rise or fall below a pre-set value, the strip exerts a varying pressure on the tensiometer roll. This is translated into an electrical signal and transmitted to a General Electric amplidyne (CR). The latter functions as a regulating exciter. It amplifies the control signal and uses it to vary the excitation of the booster generator (BG) in series with d-c motors (M) driving the No. 1 stand. As tension tends to decrease, the excitation power decreases, the motors on the No. 1 stand slow down and exert an additional drag on the steel strip. As tension tends to increase, the amplidyne increases the booster generator excitation, thereby increasing motor speed and restoring the tension to its normal value. The main generator is shown as (G). Tension is maintained between the reels and pullers as well as between the pullers and stands. An electrical signal is fed into separate amplidynes which vary the excitation of the drive motors on each reel and roll.

GENERAL ELECTRIC

660-41

SEE THESE MACHINES IN OPERATION *at the* NATIONAL METAL EXPOSITION

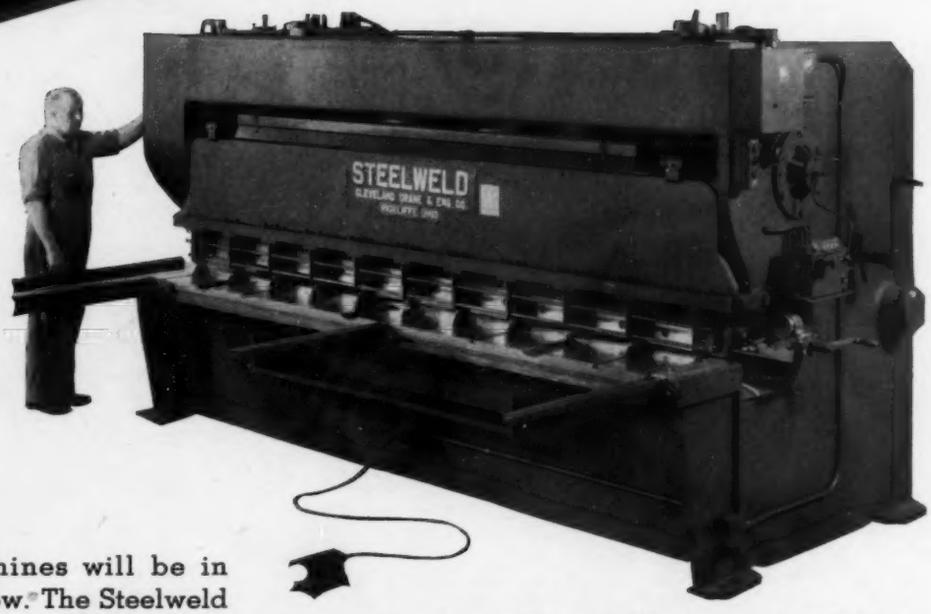
CHICAGO, OCTOBER 18 to 24



The National Metal Exposition and Congress will be held at the International Amphitheatre in Chicago.

SPACE No. 1210

STEELWELD PRESSES speed production of parts that would be difficult and costly by ordinary methods. They lower costs because press work is fast and dies are usually simple and inexpensive.



STEELWELD *Pivoted-Blade* **SHEARS** are radically different from all other shears. They have no slides or guides to wear out, and offer many outstanding advantages including electric foot switch operation.

These two heavy-duty machines will be in operation at the big Metal Show. The Steelweld Press has a bending capacity of 14' x 1/4". The Steelweld Shear is rated to cut 12' x 3/8" steel plate. Multi-hole punching, bending and shearing will be demonstrated.

We urge you to see these modern, versatile tools.

Readily adaptable to jobbing work or long production runs, they have numerous features — many heretofore unavailable — that enable you to handle more kinds of work, quicker, better, easier.

THE CLEVELAND CRANE & ENGINEERING CO.

5013 EAST 281st STREET • WICKLIFFE, OHIO

STEELWELD PRESSES AND SHEARS

Crops *and* Shorts

COMMENTING on his recent European trip, E. T. Weir, chairman of National Steel Corporation, stated that "Europe is by no means doing all that it can to help itself. The genuine recovery of Europe will start on the day that the people there roll up their sleeves and go to work — and not before."

Mr. Weir also said, "I am fully convinced that the United States must discontinue at once the practice of loaning or giving money to foreign countries without the most critical investigation of their program for the use of the money. This investigation must not be left in the hands of regular officials of our government . . . but should be put in the hands of industrialists and other practical men — according to the problem involved — who can make intelligent decisions based on experience and free from political or diplomatic pressures."

▲

IN the United States, more money is spent for government — federal, state and local — than is spent for food. Our government is now asking us to use less food. How about swapping? A little less government expense, too.

▲

ACCORDING to the American Iron and Steel Institute, steel's payrolls for the first seven months of 1947 exceeded those for the entire year of 1940. The seven month total was $1,121,808,000.

▲

A SURVEY of the "gray" market in steel among a number of steel users sets its scope at 4.3 per cent of the steel purchased by those companies. About 40 per cent of these users blame themselves, while another 40 per cent blame the steel producers.

It is impossible for the steel industry to police the ultimate destinations of its products. This is shown by the ramifications of a typical incident recently run down. In this case, a reputable electrical manufacturer needed some hot rolled strip, and furnished the necessary steel to a producer who rolled it into strip. By the time delivery was made, conditions had changed so that the electrical manufacturer did not need the strip, and so sold it. After passing through three intermediate hands, the steel, its price approximately doubled, reached another manufacturer who found the tag of the steel company who had rolled the strip and promptly blamed them for black-marketing.

AS the current steel shortage continues, steel users get farther and farther into the steel business. Most recent deal along this line is the purchase of an 84 in. sheared plate mill from Lukens Steel Company by International Detrola Corporation, who will move it to the old Andrews plant at Newport, Kentucky, which they now operate.

▲

THE automotive industry continues to be the steel industry's best customer, taking 14 per cent of the production during the first half of 1947. Construction, consuming 9.7 per cent the steel produced, is in second place.

The automotive industry is estimating their own production for 1947 at 5 million units. This is the second highest of their history, being exceeded only by the 5⅓ million cars of 1929.

▲

AT the recent Washington inquiry into steel capacity, Senator Edward Martin, speaking to steel executives about a shortage of nails, said: "In our free competitive economy, there ought to be some organization among you gentlemen to see that this sort of thing doesn't happen." Perhaps the senator should take his request to the Federal Trade Commission.

▲

CRITICISM of the steel industry for not rushing in to build new plants has at last evoked answers from the industry. After enduring the barbs of union leaders, economists and politicians in dignified silence, the industry is breaking out with statements setting forth what the various companies are doing to increase their capacity. Actually, now under construction are facilities whose annual capacities total 2½ million tons of ingots, 3 million tons of iron, 3 million tons of coke, and 3 million tons of sheet and strip. Also, the use of oxygen in open hearths and the use of oxygen or high pressure blowing in blast furnaces have shown the possibility of substantial increases in production from existing equipment. This latter form of expansion is one that has always been pushed by the industry, and it carries an additional advantage in that it can be swung into operation faster and will consume less scarce material than the construction of new plants. We believe that the industry has a good answer to the charges leveled at it of a "do-nothing" attitude and a "prosperity through scarcity" policy. We hope that the steel companies will continue to tell the public what they are doing, and not let loose talk and false accusations go unchallenged.

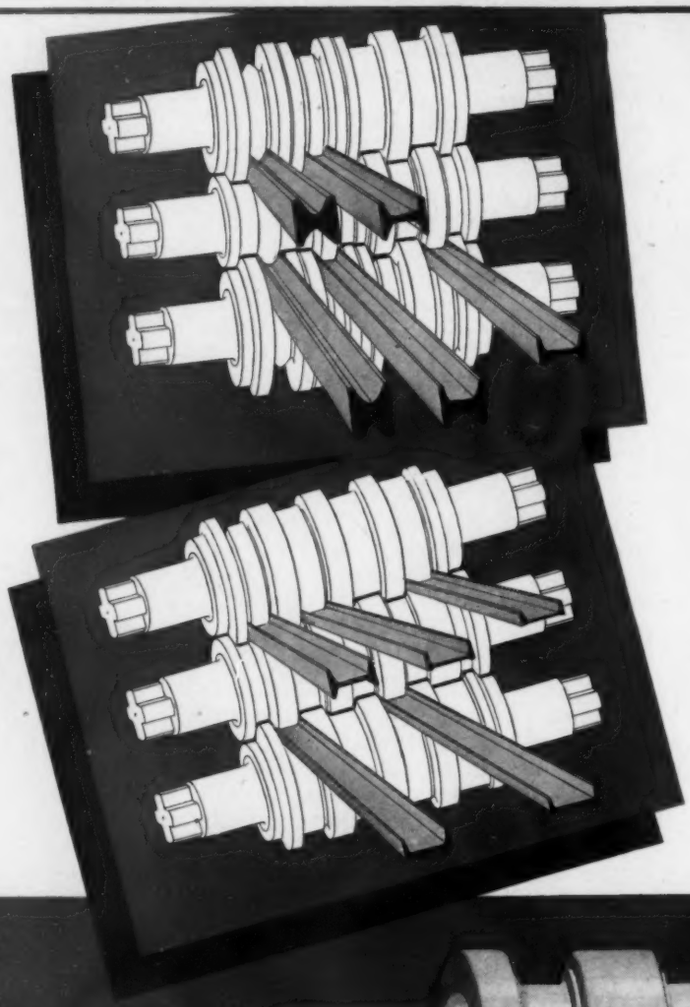
▲

NATIONAL Steel Corporation has announced that it is carrying out a program by which it expects to increase its ingot capacity by 800,000 tons per year. This is to come from the installation of converter equipment to supply blown metal to the open hearths of Great Lakes Steel Corporation, and from the installation oxygen plants at Weirton and Great Lakes. Part of this program will be finished this year, and the entire program will be completed before the end of 1949. By end of 1948, National Steel will have spent $100,000,000 for postwar expansion and new facilities.

▲

SOME sage has observed that wrecked marriages may generally be blamed on little things. Like little blondes, little brunettes and little redheads?

ROLLING TECHNIQUE . . .

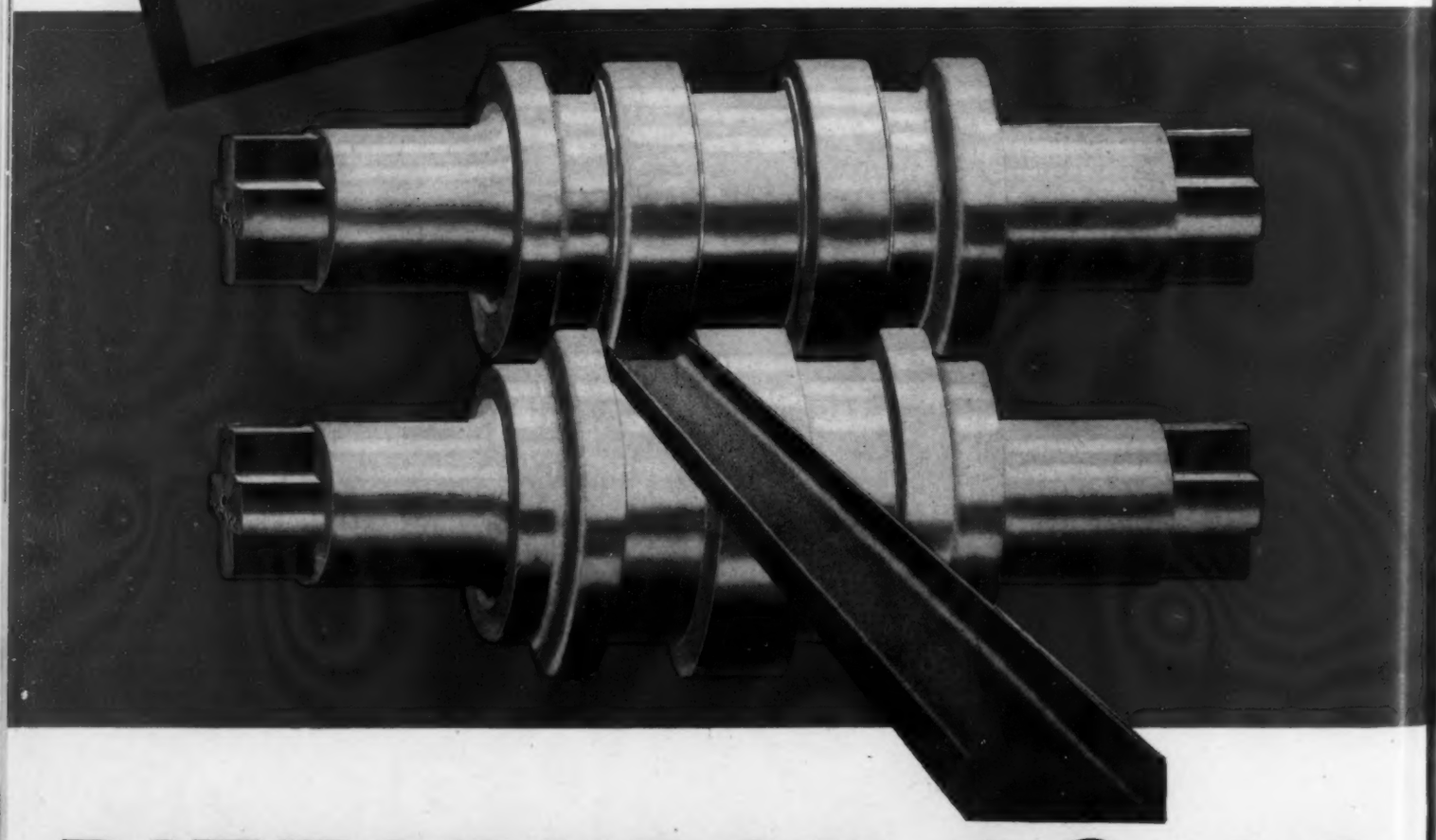


Channels

Channels of either the Standard section as shown or car or ship channels with their longer and heavier flanges present rolling problems similar to the rolling of beams, in that the deep passes necessary to form the flanges require rolls with high tensile strength as well as resistance to side wear.

Pittsburgh rolls are made by skilled craftsmen whose thorough practical knowledge of metallurgy, foundry methods and accuracy in roll turning is the accumulated result of more than seventy-five years devoted to the exclusive manufacture of rolls. The use of Pittsburgh rolls can result only in *less cost per ton of steel rolled.*

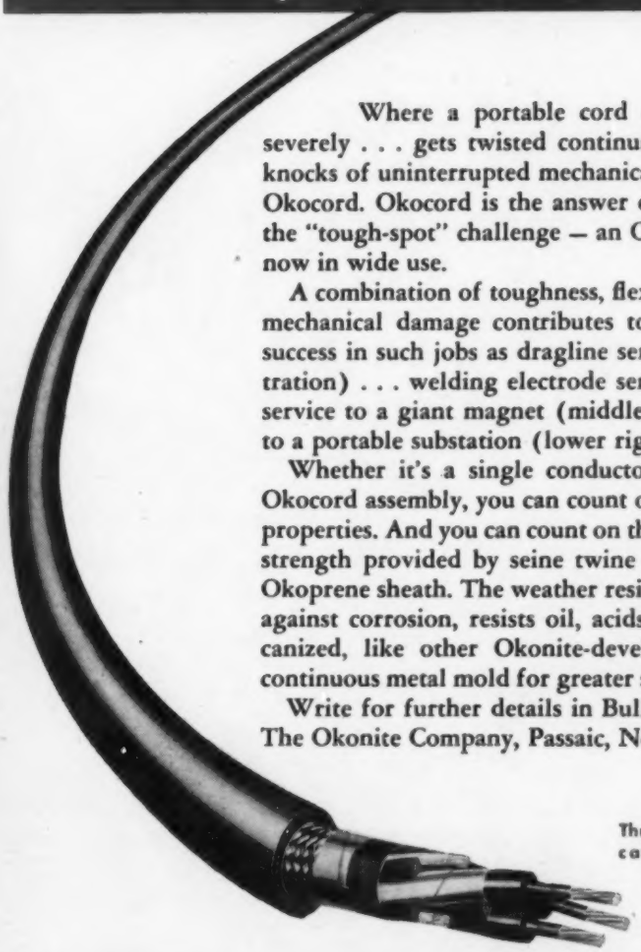
PITTSBURGH ROLLS
Division of Blaw-Knox Company
PITTSBURGH, PA.



PITTSBURGH ROLLS

tough jobs like these

Call for Okocord



Where a portable cord or cable gets punished severely . . . gets twisted continually . . . takes the hard knocks of uninterrupted mechanical abuse, give the job to Okocord. Okocord is the answer of Okonite engineers to the "tough-spot" challenge — an Okoprene sheathed cable now in wide use.

A combination of toughness, flexibility and resistance to mechanical damage contributes to Okocord's established success in such jobs as dragline service (large upper illustration) . . . welding electrode service (upper right) . . . service to a giant magnet (middle right) . . . and service to a portable substation (lower right).

Whether it's a single conductor or a multi-conductor Okocord assembly, you can count on its excellent electrical properties. And you can count on the additional mechanical strength provided by seine twine cords embedded in the Okoprene sheath. The weather resistant Okoprene protects against corrosion, resists oil, acids and alkalies. It is vulcanized, like other Okonite-developed compounds in a continuous metal mold for greater strength and longer life.

Write for further details in Bulletin OK 2062. Address The Okonite Company, Passaic, New Jersey.

Three conductor Okocord shovel cable with ground wires

Single conductor Okocord welding cable

Two conductor Okocord magnet cable

Three conductor Okocord portable power leads

6069

OKONITE insulated wires and cables

The WEAN ENGINEERING Company, Inc.
WARREN, OHIO

SPECIALISTS IN SHEET, TIN & STRIP MILL EQUIPMENT

WEAN EQUIPMENT Corporation
Cleveland Ohio

NARROW STRIP AND WIRE MILL MACHINERY

HOLMQUIST BARBED WIRE AND WIRE FENCE MACHINERY

Pickle Line

Tin Plate Shearing

Electrolytic Line

Backed Up Leveller For Wide Sheets

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F. E. ROBINSON, *Division Engineer, Projects,* American Steel & Wire Company, Cleveland, Ohio.

C. E. S. EDDIE, *Assistant Superintendent, Steam & Fuel,* Great Lakes Steel Corporation, Detroit, Michigan.

A. D. HOWRY, *Assistant Superintendent of Maintenance,* Alan Wood Steel Company, Conshohocken, Pennsylvania.

ALEX MONTGOMERY, JR., *Assistant General Superintendent,* Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania.

L. S. STEINER, *Superintendent of Maintenance,* Steel & Tufle Division, Timken Roller Bearing Company, Canton, Ohio.

E. W. TREXLER, *Superintendent, Mechanical Department,* Bethlehem Steel Company, Johnstown, Pennsylvania.

J. H. STRASSBURGER, *Manager, Service and Maintenance,* Weirton Steel Company, Weirton, West Virginia.

JOHN L. YOUNG, *Vice President, Charge of Engineering,* National Tube Company, Pittsburgh, Pennsylvania.

C. E. PRITCHARD, *Lubrication Engineer,* Republic Steel Corporation, Cleveland, Ohio.

JOHN B. MITCHELL, *General Manager of Manufacturing Operations,* Jones & Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

Managing Director
T. J. ESS
Empire Building
Pittsburgh, Pennsylvania

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In This Issue

Homestead's 160 In. Plate Mill — by W. H. Gilleland, Assistant Division Superintendent, and W. D. Hacker, Division Superintendent, Slabbing and Plate Division, Carnegie-Illinois Steel Corporation, Homestead, Pennsylvania..... 35

Economics of High Pressure Steam for Steel Mill Power — by F. A. Sawyer, Stone and Webster Engineering Corporation, Boston, Massachusetts..... 44

Discussion: Economics of High Pressure Steam for Steel Mill Power — presented by Julius H. Strassburger and John G. Greenwood..... 49

Storage Yard Materials Handling — by Frank C. Wier, Superintendent of Labor and Yards, Timken Roller Bearing Company, Canton, Ohio..... 51

Discussion: Storage Yard Materials Handling — presented by George S. Monks, W. W. Justice and T. A. Lewis..... 57

Soluble Oil in Flame Hardening Operations — by Stephen Smith, Air Reduction Sales Company, New York, New York.... 59

Discussion: Soluble Oil in Flame Hardening Operations — presented by H. W. Johnston and Stephen Smith..... 63

Modern Electrical Control for Wire Mill Machinery — by O. M. Bundy, Assistant Chief Engineer, Clark Controller Company, Cleveland, Ohio..... 64

Maintenance of Steel Mill Cranes — by A. J. F. MacQueen, Mechanical and Electrical Superintendent, Atlas Steels, Ltd., Welland, Ontario, Canada..... 72

Discussion: Maintenance of Steel Mill Cranes — presented by A. J. F. MacQueen, A. Linke, W. A. Taylor, Rudolf E. Knorr, H. E. Davis, D. W. McLean and C. G. Davis..... 76

Design of All-Basic Open Hearth..... 78

Welding Applications in Ore Bridges — by George F. Wolfe, Welding Consultant, Dravo Corporation, Pittsburgh, Pennsylvania..... 84

The Depreciation of Industrial Facilities — by Charles R. Cox, President, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania..... 86

News Supplement..... 103

Equipment..... 103

Personnel..... 125

AISE New Members..... 140

Index to Advertisers..... 153

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HOMESTEAD'S 160 IN. PLATE MILL

. . . . refinements in modern plate mill design as illustrated by Homestead's new 160 in. unit, are reflected in better quality and accuracy in the finished plate, as well as in increased production . . . .

By W. H. GILLELAND, Assistant Division Superintendent
and W. D. HACKER, Division Superintendent
Slabbing and Plate Division
Carnegie-Illinois Steel Corporation
Homestead, Pennsylvania

▲ HOMESTEAD works for the past sixty years, has been one of the leading steel plate producers of the world, not only in quantity but in quality. In order to maintain this position, it has been necessary to supply the users with quality plates possessing certain physical properties, a high degree of uniformity of gage, good surface finish, weight and physical dimensions close to the ordered weight and size, flatness, and as free as possible from camber or distortion.

The imperative demand for wide plates arising from the war, resulted in the erection of the mill, now known as Homestead's 160 in. mill, which forms an integral part of a huge new development, consisting of a modern open hearth, 45 in. slabbing mill, heat treating, forge and machine shops, with accompanying maintenance and roll shops. This adjoins the established 100 in. semi-continuous plate mill. Homestead's 160 in. mill first rolled a slab into a plate in February, 1944.

The production of this mill was successfully used in the war and the equipment is sufficiently flexible to meet the demands of a nation at peace. It is capable of producing plates having the quality characteristics of the narrower and medium width plates in extreme widths. Its products are not limited to carbon or tradetype steels, but include alloy and high strength grades. Neither are they limited to the lighter gage plates but extend far into that field of products requiring flame cutting.

Unlimited possibilities abound in manufacturing practices in which flame-cut products may be incorporated. Pantograph machines make possible a supply of many intricate shapes, from a small chain link to locomotive side frames. Flame planers supply the rectangular shapes, while portable machines turn out the less complicated sketch plates.

The description of details of the mill layout and facilities will follow, but first we wish to mention briefly the outstanding features of this mill, made possible through the foresight of the corporation. This has resulted in a mill capable of producing wide plates of the quality demanded by the trade.

First, mention should be made of the most important piece of equipment, the four-high finishing stand. It is second to none, exceeding expectations and doing more than thought to be possible for a mill of its type. It has both power and speed, plus the added feature of movable side guards, which make it possible to keep the plate centered in the mill at each pass. Crowned work rolls, 38 inches in diameter, backed up by rolls 59 inches in diameter, are operated through the rolling cycle by a simplified, automatic, two-schedule, 13-pass screw-

The continuous slab furnaces are fed by double rack type pushers.

Presented before AISE Pittsburgh District Section Meeting, January 13, 1947.

The batch type furnaces are fed with a 20-ton stiff-leg, swivel, charging crane.

down control. An optional manual control is also provided which can interrupt or make any adjustment to the screw setting without affecting the accuracy of the following automatic setting. Uniformity of gage and weight are made possible through this combination. Varying speed drives and hydraulic cleaning sprays, operating at a pressure of 1500 psi, contribute their part to the plate's quality in the way of surface "finish."

The features set forth in the previous paragraph are not entirely responsible for the plate qualities mentioned. The finishing stand must have delivered to it a slab, well heated and free from scale, in order that the work rolls can maintain their highly polished surface. This is accomplished through:

1. Continuous and "batch" or "in-and-out" type slab heating furnaces, equipped with full automatic combustion controls which assure close temperature control at all times throughout the heating cycle. This is particularly desirable in heating alloy steels when various drawing temperatures are necessary. The size slabs that can be heated in these furnaces, (120 × 60 × 12 in. at 23,000 lb. — "continuous") (144 × 55 × 20½ in. at 43,500 lb — "batch") not only make it possible for these wide plates to be rolled in lengths up to 720 inches, but make the 160 in. mill a major producing unit.
2. The two-high scale breaker stand, with fluted rolls and 1500 psi hydraulic cleaning sprays, effectively removes the relatively light furnace scale from the slab before delivering it to the finishing stand.

The finishing facilities incorporated in the mill layout contribute the remaining quality characteristics. Long conveyor tables, which permit the product to cool to desirable temperatures, deliver the plates to heavy, quick operating shears, with knives set at a minimum "rake," and capable of shearing mild steel plates up to 1½ in. in gage with a minimum of "shear-bow." Manipulation and positioning of the plates in the shear, by means of electro-magnets, plus the plate cooling mentioned, assure quality in the way of accurate dimensions and close weights. Extensive flame cutting facilities are provided to process those products in which size, shape, or chemistry prohibits their being sheared. Auxiliary equipment, such as normalizing furnaces, preheating and controlled cooling hoods and pits, are provided to process those products requiring such treatment.

The equipment herein mentioned is by no means the extent of the 160 in. mill's facilities. However, innovations in plate mill design are represented which contribute the major distinctive characteristics to the mill's products.

Following is a more detailed description of the mill's layout and equipment.

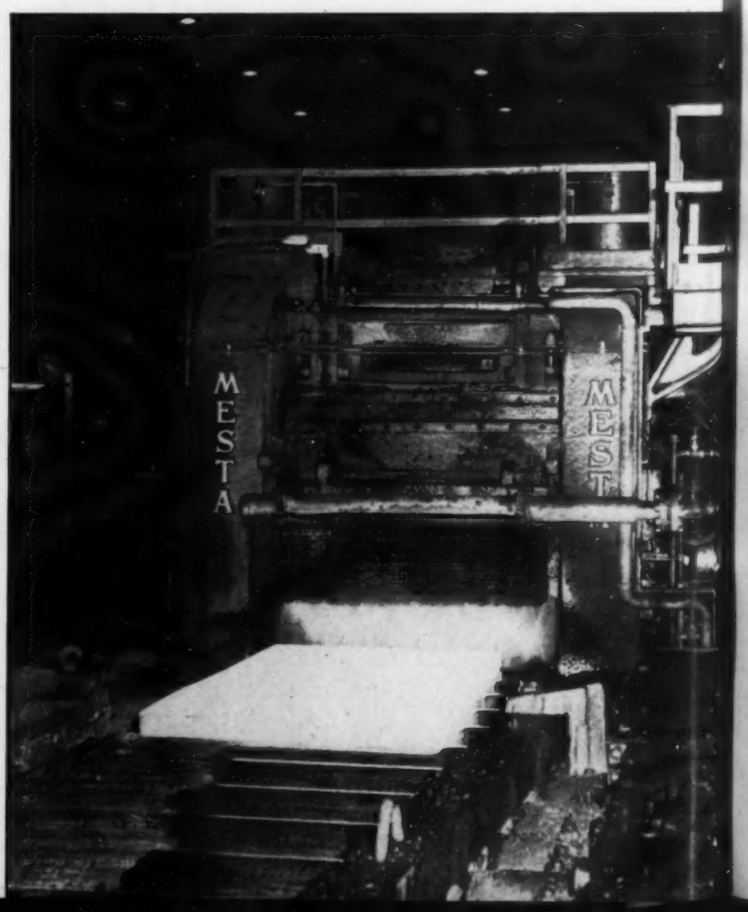
SLAB STORAGE YARD

The "cold-slab" stocking practice is employed in scheduling the mill's production, which means that each slab is individually inspected and any defects removed by flame scarfing before being placed in the slab storage yard and subsequently assembled for rolling, according to mill conditions, commitment date, customer, etc. The storage yard is 470 ft in length and 110 ft in width, and has ample space to stock approximately 15,000 tons of slabs. There are 6 gas-fired preheating pits located in this yard, each having a capacity of approximately 10 slabs (50 ton) and capable of heating cold steel to a temperature of 1200 F in 24 hours. In addition, there are 3 gas-fired preheating hoods, each having a capacity of approximately 120 tons and capable of heating cold steel to a temperature of 1600 F in 24 hours.

The yard is parallel and adjacent to the slab conditioning yards of the 45 in. slabbing mill.

While the majority of the slabs produced for the 160 in. mill are rolled on the 45 in. mill, all slabs received

The scale-breaker is also equipped with a top and bottom high pressure spray operating at 1500 psi. Shown here is the delivery side.



in the slab storage yard are transferred through the slab mill's conditioning yards by means of standard gage shuttle cars, powered by a 25 ton diesel-electric locomotive and by two electric powered slab transfer cars. Slabs are assembled in the slab storage yard according to planned rolling sequence and served to the mill reheating furnaces by means of two standard gage shuttle car transfers, powered by 25 ton diesel-electric locomotives. One of these transfers is a continuation of the transfers serving the slab conditioning and storage yards already mentioned. The yard is serviced by two 30 ton electric overhead traveling cranes.

SLAB HEATING EQUIPMENT

The slab heating equipment consists of two continuous type furnaces and two "batch" or "in-and-out" type furnaces. These furnaces were selected after much deliberation, taking into consideration anticipated product mix and equipment which would readily lend itself to maximum flexibility.

The "batch" type furnaces are designed to heat slabs of a maximum size of 144 in. long × 20½ in. thick. They are two-zone controlled, end-fired, recuperative type furnaces with an effective hearth area of 46 ft in length × 12 ft in width. They are designed and equipped to operate on a mixture of coke oven and natural gas and have a rated capacity of approximately 15 tons per hour (cold to 2250 F). Each furnace is provided with two doors, each door being made up of three sections without jambs, each one of which may be operated independently. With this arrangement of doors, either half of the furnace may be thrown completely open with no door frame or jamb interference whatever, and the entire furnace front may be opened with no obstruction other than the center jamb. These furnaces are served by a 20-ton stiff-leg swivel charging crane which can effectively cover the furnace hearth area when charging slabs, and is used to draw and deliver the heated slabs to the furnace delivery table.

The continuous type furnaces are designed to heat slabs from 70 to 120 in. long and from 3 to 12 in. thick. They are the conventional two-zone controlled, triple-fired, end charged and discharged recuperative type furnaces and have an effective heating length of 80 ft and an inside width of 23 ft. They are designed for both top and bottom firing in the primary heating zone. These furnaces are designed to operate on a mixture of coke oven and natural gas of approximately 600 Btu per cu ft average heating value, but are so equipped that they can be operated on fuel oil in the firing zone. The heating capacity of each furnace is approximately 70 tons per hour, (cold to 2250 F).

These furnaces are served by a 30 ton electric overhead traveling crane which takes the slabs from the transfer cars by means of magnet or slab handling tongs and places them on the furnace charging table. The slabs are fed through the furnaces by double rack type pushers arranged to feed two rows of slabs through each furnace. Slabs are discharged from the delivery end, and slide down chutes to the furnace delivery table against spring backed bumpers.

High production and yields can be maintained on the mill with this combination of furnaces, which permit the providing for long heavy plates in longer, thinner slabs, resulting in less heating time per ton of slabs, fewer breakdown passes and multiple length rolling. The "batch" type furnaces permit the heating of small-lot quantities of special grade and alloy steels, requiring various drawing temperatures and close temperature control.

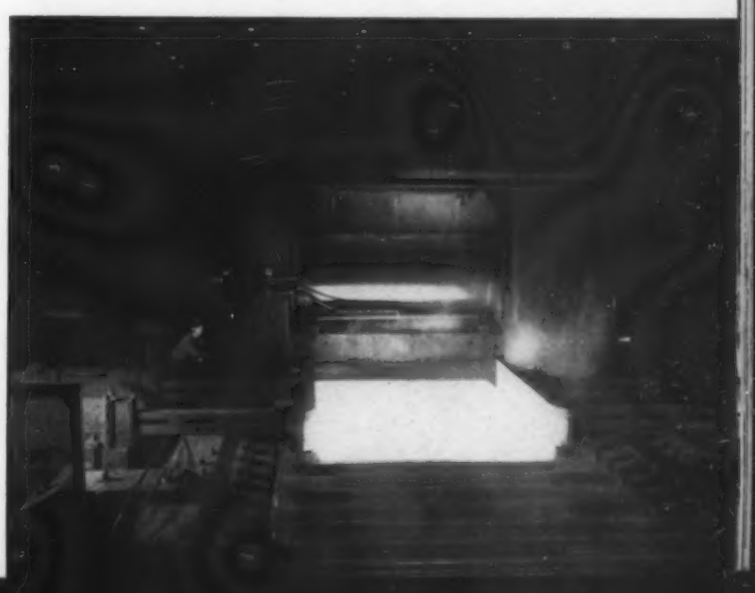
A slab turn-around, between the scale-breaker and the mill, eliminates turning the slab in the mill.

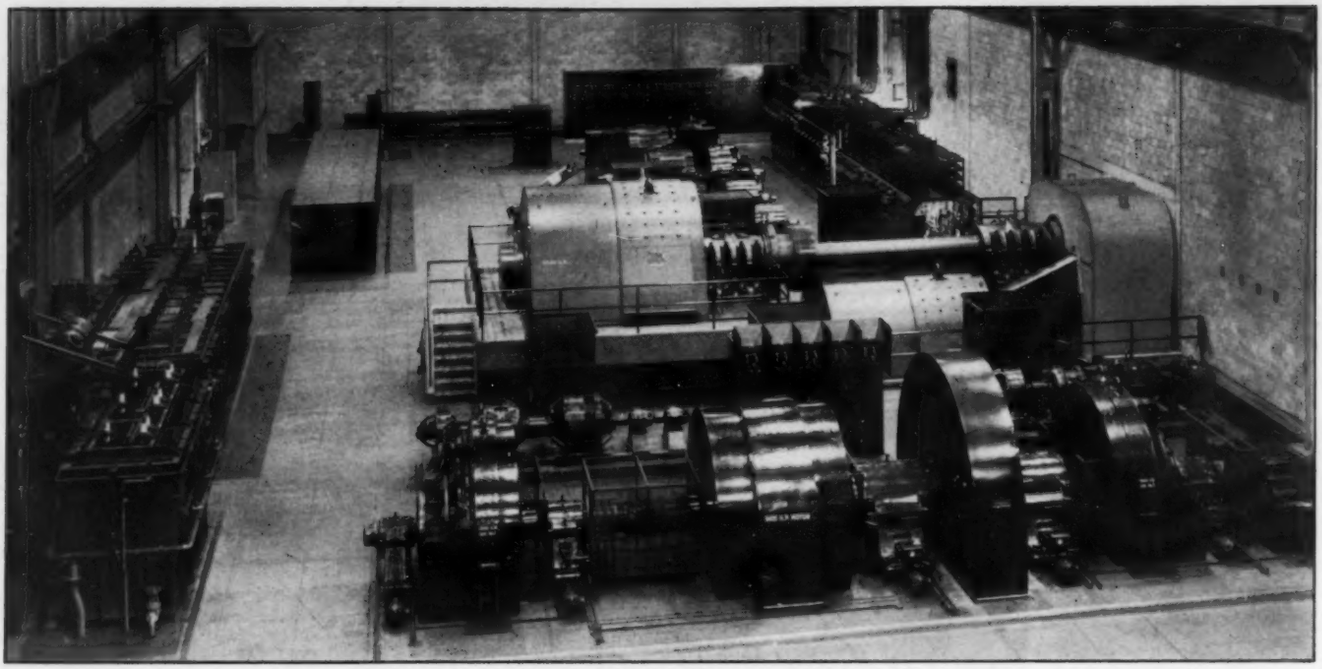
SCALE-BREAKER

Slabs, after leaving the furnaces, pass through the scale-breaker which is a two-high mill, driven through a pinion stand by means of a 1600 hp, 492 rpm, 660 volt, 3-phase, 25 cycle, a-c wound rotor induction motor. Power is transmitted through a double reduction flywheel gear drive, universal leading spindle, mill pinions and universal mill spindles, resulting in a driving speed of 295.6 fpm.

The rolls are alloy steel, 36 in. in diameter × 70 in. in body length, with flutes having alternating radii of

Movable side guards are provided on both sides of the 160 in. mill for squaring and centering the slabs and holding the plates. The picture shows the delivery side of the mill.





The main rolls are each driven directly from a 5000 hp, 700 volt, d-c reversing motor. Shown in the foreground is the motor-generator set which is driven by a 9000 hp motor.

3/16 and 1/2 in. The roll neck bearings for this mill are of the composition type, using service water as the lubricant. When the mill is operating, a shot of water soluble oil is added to this water supply every 20 minutes and regulated through an automatic timing device. This added means of lubrication has proven helpful in increasing bearing life.

The top roll is balanced by means of carrier bars supported from a yoke which is actuated by hydraulic jacks and accumulator to hold the top roll against the housing screws. The screws are driven by a 50 hp motor through one stage of gearing to a worm meshing with a worm wheel on each screw and operates at a speed of 11 in. per minute.

The selsyn producto-meter in the operator's pulpit gives the operator a reading of the opening between rolls at all times. Twin adjustable side guides having a maximum opening of 68 in. are situated on the entry and delivery sides of this stand.

The stand is equipped with an additional descaling facility in the form of a top and bottom high pressure spray operating at 1500 psi. This means of scale removal (fluted rolls and high pressure hydraulic sprays) has proven very satisfactory, particularly on alloy steels where a hard tight scale is prevalent.

SLAB TURN-AROUND

The slab, after leaving the scale-breaker, is turned 90 degrees by means of a lift and turn device. The turn table is elevated and lowered by oil hydraulic pressure and turned by a motor operated rack and pinion. This eliminates the necessity for turning the slab in the mill, since the slab, as delivered, is ready for the first spreading pass as soon as the previous plate is finished. The distance from the scale-breaker to the four-high reversing mill is 160 ft.

FOUR-HIGH REVERSING MILL

The main mill stand is a reversing four-high stand with alloy steel back up rolls 59 in. in diameter and 154 in. in length of roll body with 1/2 in. chamfer at each end. The back up roll necks are 33 in. in diameter and supported in oil film bearings operating at 17 psi oil pressure. These rolls are anchored to the mill housing through two-row steep angle tapered thrust bearings.

The alloy iron work rolls are 38 in. in diameter and 160 in. in length of roll body. The work roll necks are 27 in. in diameter and are supported with four-row tapered roller bearings. The top rolls are balanced by hydraulic jacks mounted in the bottom back-up chucks, with the hydraulic system operating at 3700 psi.

The back-up rolls are moved into and out of the mill on a motor-driven slide. The work rolls are changed by a means of a "C" hook, with a motor-driven shift of the hook suspension between the center of gravity of the empty hook and the center of gravity of the loaded hook.

The mill screws are operated by two 150 hp mill type motors, supplied by a variable voltage motor-generator set with shovel generator characteristics. A 13-pass, two-schedule, pre-set, automatic screw-down control, with optional manual control, is provided for this mill. Provision is made so that one schedule can be set up while another is being run. The operator can also make manual adjustments to the setting of the screws at the completion of, or can interrupt any automatic setting without affecting the accuracy of the following automatic stop. The main drive for this mill is an innovation

in plate mill application. It consists of two 5000 hp, 700 volt, d-c reversing motors, one driving each roll without mill pinion, through universal spindles 36 ft long. The motors are capable of speeds from 40 to 80 rpm which provides a roll surface speed of 400 to 800 fpm. At present the mill is operated at 40 rpm, with the exception of straight-away passes on slabs finishing to under ½ in. gage, which are made at 60 rpm. The control is operated by the screw-down operator, who also reverses the mill drive.

The main drive motor-generator set is a four unit flywheel set, consisting of one 9000 hp, 375 rpm, 6600 volt, 3-phase, 25 cycle, a-c wound rotor induction motor with flywheel, having a total energy content of 245,000 hp-sec at 375 rpm. There are three 3000 kw, 700 volt generators. The mill is served by front and back reversing tables, each 33 ft long and having tapered rollers. The even numbered rollers are larger at one end than at the other, and the odd numbered rollers are larger at the opposite end. The drives for the rollers follow the same plan, i.e., alternate rollers being on separate motor drives. These drives are powered by four 50 hp mill type motors supplied by a variable voltage motor-generator set which is a duplicate of the one supplying the screw-downs. With this equipment, it is possible to turn a slab as desired, by operating the alternate rollers in opposite directions. Sturdy movable side guards are provided on each side of the mill for squaring and centering the slabs and holding the plates during the rolling operation.

Another interesting feature, worthy of note, is the particularly effective roll cooling obtained through the cooling sprays being supplied from a re-circulating water system, at a pressure of 150 psi.

The main mill building is serviced by two electric overhead traveling cranes, one of 100 ton and the other of 35 ton capacity.

Rolls are transferred between the main mill building and an adjoining roll shop via a standard gage shuttle car, powered by a gasoline-type tractor.

HOT LEVELER

The distance between the four-high mill and the leveler is 216 ft. A plate cooling spray is located along 180 ft of this distance and is constructed to spray the top and bottom surfaces of the plate as it moves along the delivery table to the leveler. By this means, plates are cooled to desirable temperatures prior to leveling without delaying the mill. These sprays have been particularly beneficial in the processing of the heavier gage plates in securing better plate surface by reducing the formation of secondary scale.

The leveler is equipped with movable side guards and designed to level plates up to 1 in. in thickness, up to 72,000 lb tensile at 1200 F, although we are effectively leveling plates 1½ in. in thickness and can remove sweep from plates of much heavier gages when processing hot from the mill.

The pinch rolls are 16 in. in diameter × 160 in. long and the work or bending rolls are 13 in. in diameter × 160 in. long.

The selective screw-down assembly is equipped with

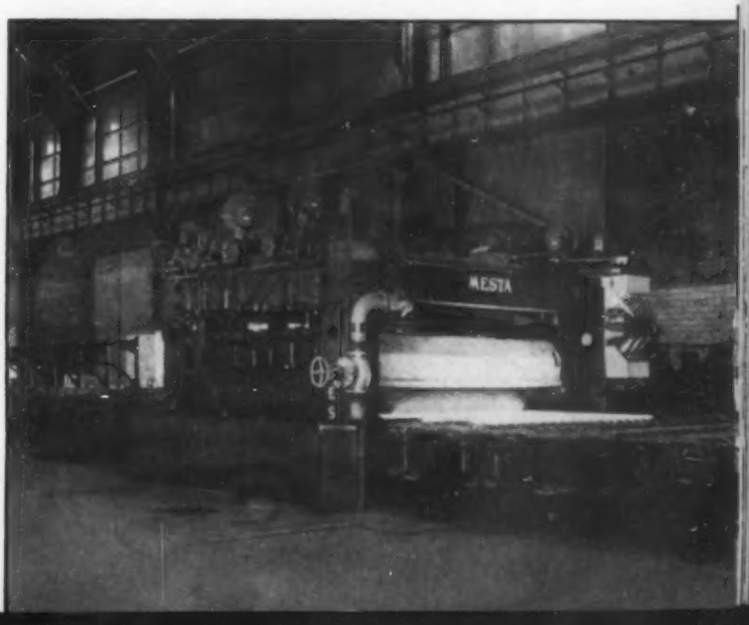
Plate cooling sprays reduce delays and also the formation of secondary scale.

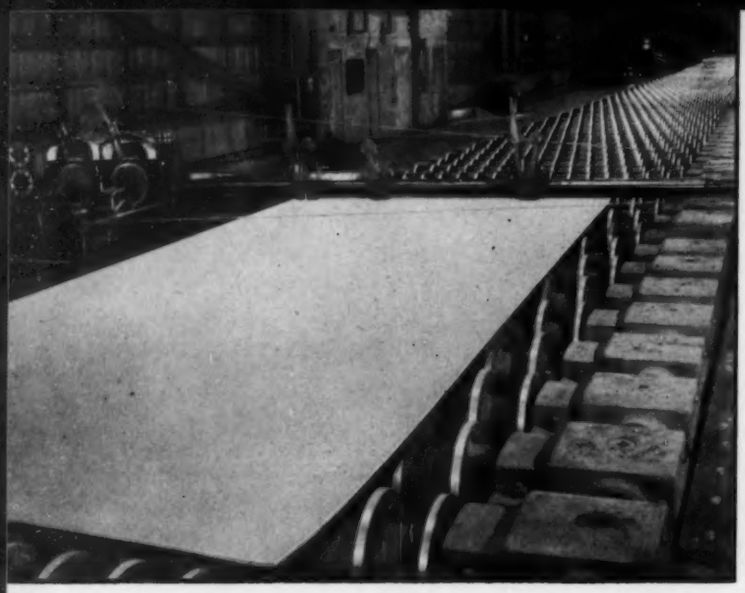
drum indicators located at all four corners of the leveler housing. The maximum lift of this machine is 6 in. A section of table on each side of the leveler is so designed that heavy plates can be lifted off the tables by means of a "C" hook and placed on either of two motor-driven transfer cars, and subsequently transferred to the cooling area of an adjoining building for flame cutting, or to the shipping yard where means are provided for the controlled cooling of such product.

PLATE MARKING

Plates that are not diverted at this point are delivered from the leveler onto a chain transfer bed. The plate cools while traversing this grid-type bed, which is 120 ft in width, and is delivered onto the marking table. This table is 292 ft in length and is located in the shear building. A motor-propelled automatic measuring ma-

The leveler is designed to level plates up to 1 in. gage.





An automatic, motor-propelled measuring machine can mark off any size or shape plate desired.

chine, manned by an operator, travels at a maximum speed of 215 fpm along a 140 ft section of this table. Indexed longitudinal and transverse movements enable the operator to measure and mark off mechanically any desired size and shape of a rectangular plate, and scribe a reference line which is used by the No. 1 side shear operator when shearing the plate side-crop. The side shear referred to is so constructed that the knife edge is not visible to the operator, and he, therefore, lines up the reference line with other reference lines machined in the shear block and table rollers at a distance of 24 in. from the knife edge. Accurate layout to ordered dimensions can be accomplished, since most of the shrinkage has taken place in the length of travel from the finishing stand to the marking table.

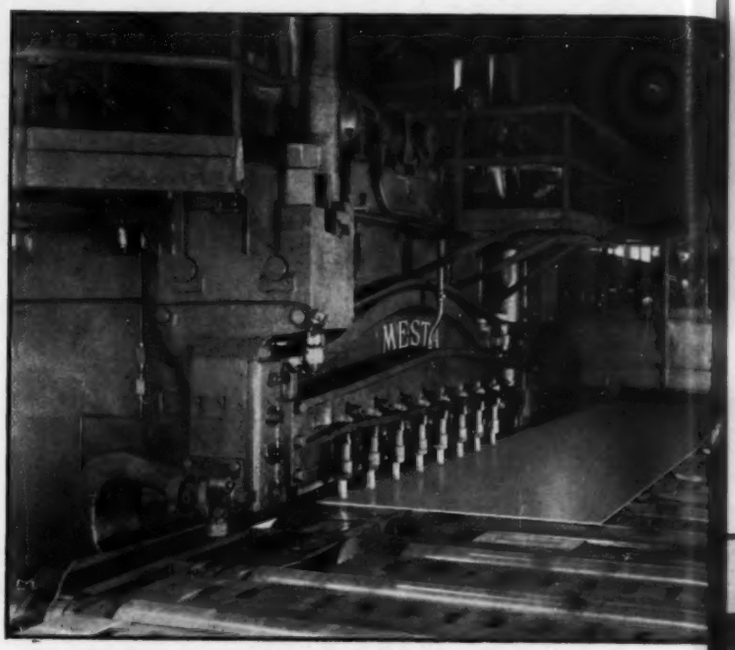
As the plate leaves the marking machine and travels towards the crop shear, the identification, marks, and test coupons are die-stamped, painted, or otherwise marked in accordance with specification.

CROP SHEAR

The crop shear, located at the end of the marking table, is capable of shearing any width of mild steel plates the mill can produce up to 1½ in. in gage. This shear is of the down-cut guillotine type with knife blades 160 in. in length, and with a knife rake of ½ in. per foot. The shear operates on the oil hydraulic principle at pressures of 7000 to 9000 psi, and has a self-contained pump with motor drive. It contains two main hydraulic cylinders with plungers of equal area which exert downward pressure against each end of the shear ram. The equal hydraulic displacement required to produce parallel movement of the upper knife is delivered to the two main cylinders by a single stroke of a duplex pump having two cylinders of exactly equal displacement. These cylinders are piped separately to each of the shear cylinders. Shears of this type eliminate the use of a clutch.

The crop shear is used for dividing plates which are too long to pass over a second transfer, and for finish shearing the front end of those plates which are of sufficient width and gage as to require shearing "fins down." Plates up to 1 in. in gage and 100 in. wide have been finish sheared at both ends on this shear without appreciable shear bow. The shears, equipped with oil hydraulic hold-down gags, operate at 1700 psi pressure which give a very positive clamping action while the plate is being sheared.

The scrap shear provided for the end shear is a motor-



The side shears are 180 in. long, whereas the cropping shear is 160 in. long.

driven, 150 hp, guillotine type, capable of shearing 33 sq in. cross-sectional area. A butterfly chute arrangement diverts test coupons, "block sheared," to a test box where they are periodically transferred to a test cutting shear for final shearing.

After leaving the crop shear, the plate is delivered to a chain transfer, 68 ft long and 84 ft wide by means of a run-in table. The run-in table is extended 40 ft past the transfer and is equipped with roll off, lifting arms and a side piling bed. This equipment is used when diverting material which requires flame cutting or other processing out the shear line. The transfer run-out tables double back through the shear building and are parallel to the marking line.

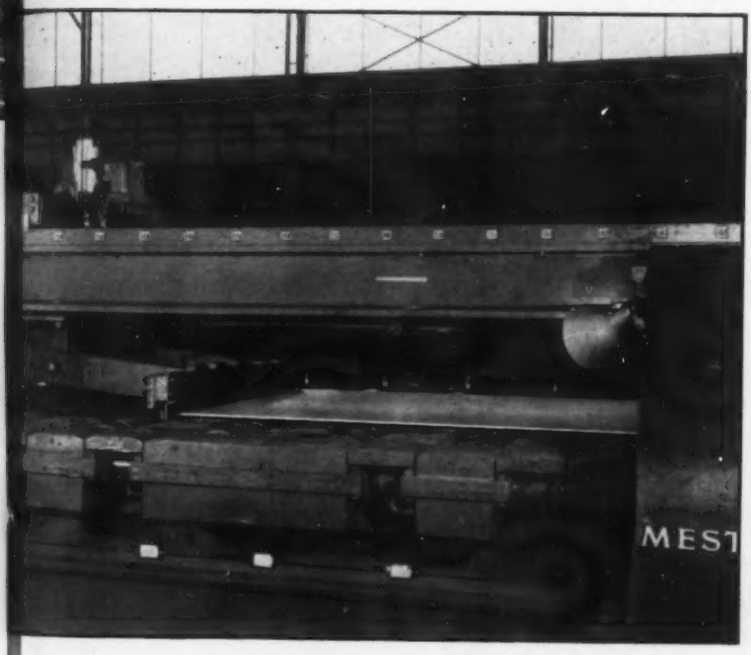
MAIN SHEARING LINE

The principal shearing line consists of two side shears and one end shear. These shears are exactly alike in design and construction as the crop shear just described, with the exception that the side shears have knives 180 in. in length. The side shears are staggered on either side of the table and are 78 ft apart. The side crop is sheared at No. 1 side shear by positioning the plates to the mentioned reference line. Alignment in

positioning the plates for shearing is accomplished by a series of electro-magnets located between the table rollers and situated in groups of four, with eight magnets in front of each side shear. The magnets are raised and lowered hydraulically and are moved transversely by means of a screw drive. The shear operator can preset by selection any combination of magnets he desires to use, and then the control is actuated by two levers, one to raise and energize, and the other to control transverse movement. This system provides a rapid means of manipulation and positioning. A mechanical width-gage guide is provided at No. 2 side shear which facilitates the positioning of the plate by working against the finished sheared edge, and its position in relation to the shear knife is recorded on a dial located on the shear housing.

The side shear is provided with an alligator-type, 75 hp, scrap shear with a capacity of 30 sq in. of cross-sectional area. The scrap travels along conveyors to the scrap shear located below the level of the shear table and, therefore, makes it possible for long plates to overhang the table at this point when making angle cuts. The scrap is then collected in buckets by gravity chutes.

The end shear is a duplicate of the crop shear and is equipped with squaring pushers located on the entry side and two motorized gage stops on the delivery side which mechanically gage to pre-determined lengths. One stop is used for short length plates and the other



Gage stops used for end shear.

long length plates, in that plates 60 to 720 in. in length can be sheared. The distance between No. 2 side shear and the end shear is 84 ft.

PILING

Plates are delivered from the end shear to a section of the scale table which is 720 in. long, where they are individually weighed. They then proceed to a section of table covered by two transverse electro-magnets on the piling cranes. As in the case of the shear table magnets, the magnets on the piling cranes are of the selective type, and afford numerous combinations in their use since the cranes can be operated individually or together as desired. One crane can handle a plate 360 in. in length, and the two cranes working together can handle a plate 720 in. in length.

These cranes transfer the plates into the shipping building where they are deposited and piled on gravity conveyor tables, and subsequently are moved along the table by a conveyor chain carriage dog into a position where the piles can be handled by overhead cranes. These piling cranes have sufficient "lift" to enable inspection of the bottom surface of the plate at this point.

SHIPPING BUILDING

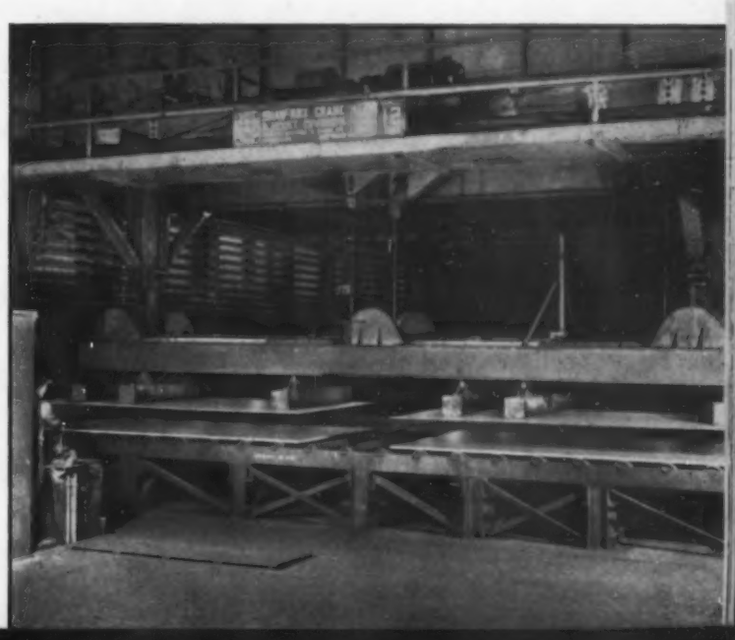
The shipping building is 110 ft wide × 1100 ft long and is provided with a shipping track with a capacity of 22 cars extending its entire length. A connecting spur track of an 8 car capacity is located in an adjoining lean-to section of the building. This track is not serviced by overhead cranes and is used for preparing cars which require special blocking either prior to or after loading. The shipping building is serviced by four, 30 ton, electric overhead traveling cranes of the double hoist type. This building also houses an area provided with controlled cooling hoods for material requiring this type of treatment.

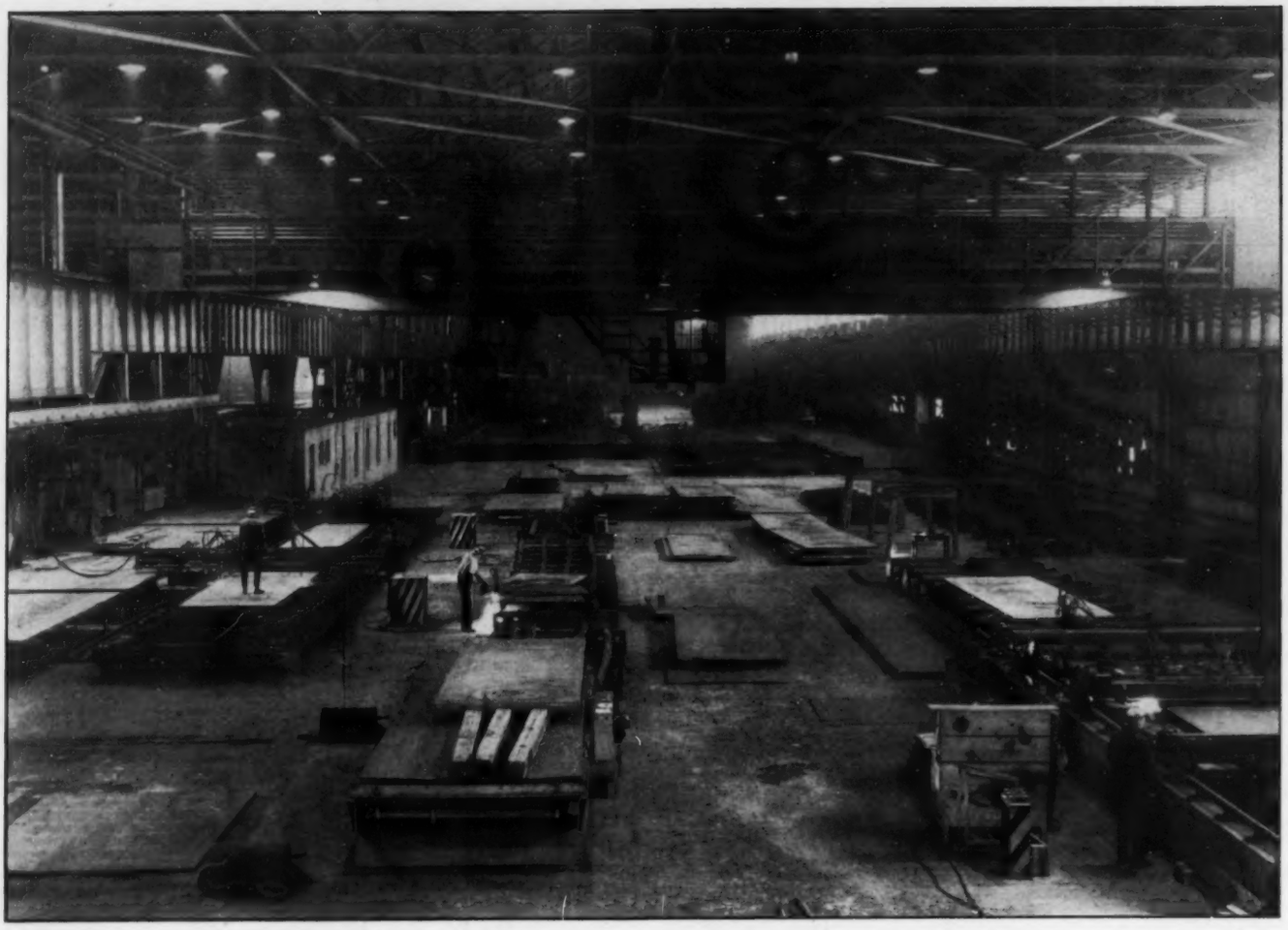
Two additional inlets into this yard, other than the piling cranes just mentioned, are provided in the form of motor-driven transfer cars located at the extreme ends of the building. One car delivers direct from the mill building and the other car delivers from a flame cutting unit located in the end of the shear building.

FLAME CUTTING FACILITIES

Incorporated in the 160 in. mill layout are two flame cutting units. One unit is located at the end of the shear

The magnets on the piling cranes are so arranged that they can be used in a number of combinations.





Two flame cutting units are used in the mill layout.

building and is serviced by a 30 ton crane, which operates on the shear building crane runway. Three pantograph, sketch cutting machines, as well as a flame planer, are located in this area. The flame planer is designed primarily for side and end trimming as well as splitting rectangular shaped plates. These operations can be performed simultaneously by flame cutting machines mounted on motor-driven carriages, which in turn travel along rails over a motorized section of conveyor table. Motor-driven entry and delivery tables servicing this machine make it possible to keep the equipment operating continuously most of the time. The pantograph machines are designed primarily for intricate shape cutting, although they can be used efficiently for cutting rectangular shapes. Magnetic tracing mechanisms, traveling over templates or operated manually over sketch drawings, guide the torch through the course desired. The close dimensions obtained on flame cut plates are real machine-hour savers in the fabricating shops. In many cases, the flame cut surface is used as the finished surface, since its smoothness and square edges do not warrant machining.

The other flame cutting unit is located in a building, 110 ft × 375 ft, parallel and adjacent to the mill building. A continuation of this building merges with the end of the continuous furnace building, and the two 30 ton cranes, servicing this unit, operate on a common runway with the crane servicing the continuous furnaces. This unit is equipped with three pantograph sketch cutting machines, two large heat treating ovens, and a heat treating pit. The heat treating facilities are used extensively in preheating, stress-relieving, normalizing and the controlled cooling of flame cut products requiring these treatments.

The heat treating ovens can also be used for preheating slabs prior to charging in the slab heating furnaces when such practice is necessary. Cooling skids are provided in this area for heavy gage plates which are transferred hot from the mill by means of a 200 ton transfer car mentioned previously in this paper.

TEST SHEAR

A motor-driven, guillotine-type test shear, with adjustable hold-down, is also located in the shear building. This shear has a capacity of 27 sq in. of cross-sectional area and has performed very satisfactorily in the shearing of test coupons.

LUBRICATION

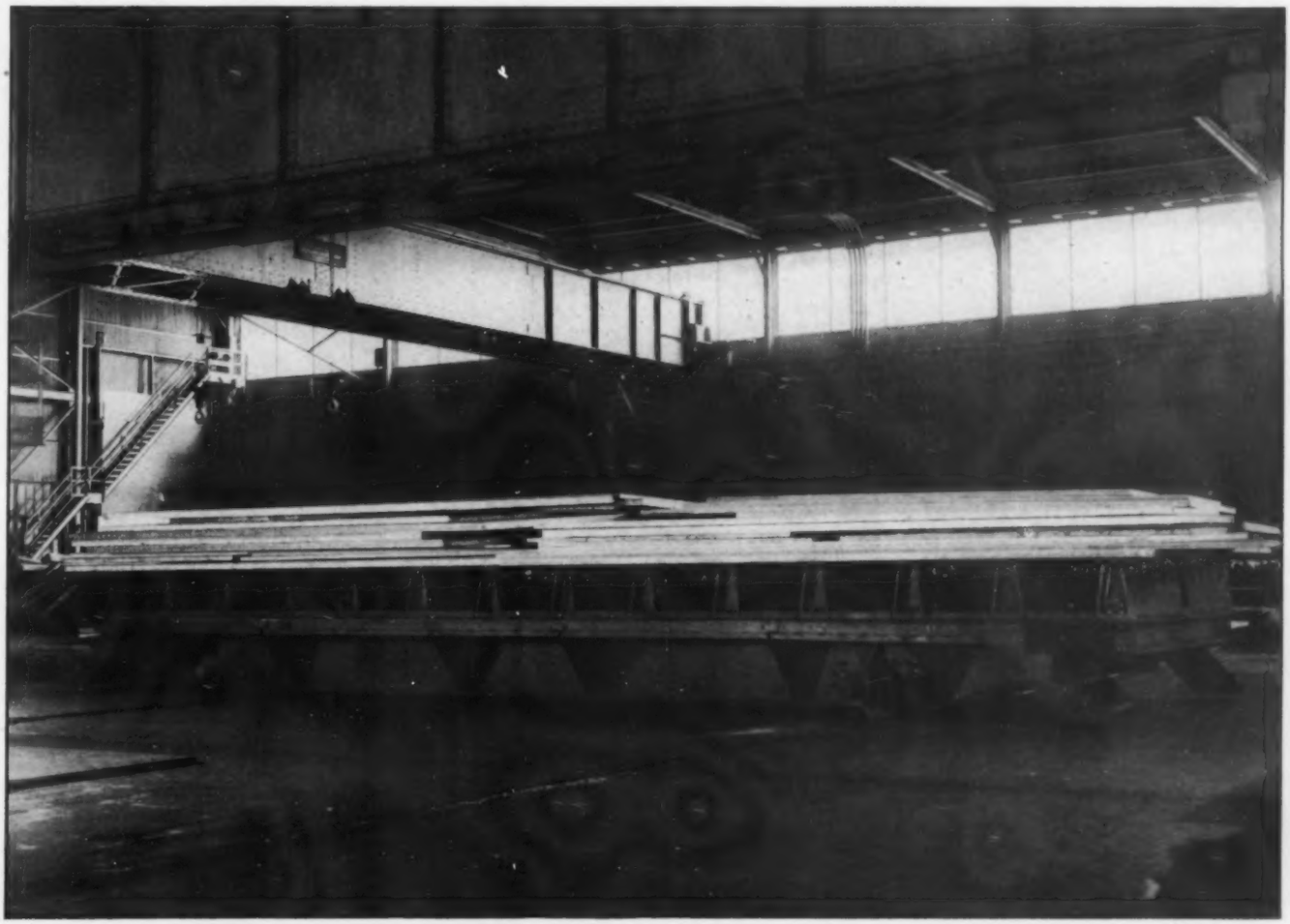
The greasing system for all table bearings, spindles, spindle carriers, jacks, slide points, etc., is of the auto-

matic "single-line" reversing type and contains 11 major pumping units. Each pumping unit incorporates 6 minor systems, any one of which may be selected through a 6-way valve, and the unit can be regulated so one system is maintained on automatic and the remaining systems brought into operation on a "when needed" basis. One feature of these systems which makes them particularly reliable is that distribution of grease to specific points is accomplished by boxes located on the main supply line of the system, which eliminates any distribution being made by headers off the supply line. This means that no point of distribution can be by-passed without knowledge of the operator. Hand pumps are employed in those locations where it was not feasible to install automatic pump systems, such as cranes, etc.

Oil lubrication for the majority of the equipment, such as, table line shafts, gears and bearings, leveler drives, screw-down drives, reduction gears, pinions, back-up roll bearings and motor room equipment, is accomplished by circulating systems of the single and double tank types. There are 7 major systems ranging in capacities from 550 gallons to 15,000 gallons. There is some miscellaneous equipment that is not on the circulating systems but operates in an oil bath. The tanks in the circulating systems have single baffles, and each system incorporates double pumps as a safety measure as well as a low pressure alarm system for added protection. Periodic analysis of the oil in these systems determines when cleaning is necessary and this operation is performed by portable centrifuging units. In the interest of economy, additives are combined to straight mineral oil in making up the extreme pressure lubricants employed in any of these systems.

In summary, the designer's objective to provide flexible equipment, capable of producing extreme-width plates with those same desirable characteristics obtainable in the narrower widths, and so arrange this equipment in a mill layout to effect an efficient flow of products, has been fulfilled. While its annual rated capacity is approximately 600,000 tons, Homestead's 160 in. mill has not had full opportunity to exhibit its potentialities during its relatively short existence because of work interruptions common to the industry.

Two 200-ton transfer cars are used to deliver plate to the shipping building.



Economics of High Pressure Steam FOR STEEL MILL POWER

. . . . few steel plants have power stations operating with steam pressures in excess of 500 psi . . . . high pressures offer possible economies operating labor costs, circulating water, and fuel . . . .

By F. A. SAWYER

Stone & Webster Engineering Corporation

Boston, Massachusetts

▲ IT IS the purpose of this paper to set forth the advantages to be gained by installing power stations for steel mills to operate at pressures and temperatures as high as those found in the more efficient public utility stations and in some modern power plants for oil refineries and industrial plants.

High pressure is a relative term and in this paper high steam pressures are considered as being in excess of 500 psi gage. Steam temperatures for efficient overall plant design for condensing turbine generators range from 750 F to 1000 F. A search of records of existing steam electric installations in steel mills reveals that there are not more than six plants in the United States operating at pressures higher than 500 psi gage.

In general, the steel industry has grown with the demand of the country and the world through the development of machines for improving the living conditions of mankind; its growth was part of the industrial revolution. During the early years, growth was rapid and attention was not paid to all items entering into production expense. However, the American prerogative of free competitive enterprise has induced a progressiveness demanding reduced costs of production to the country by means of improvements in manufacturing methods.

Steel, being one of the basic industries of our economic system, has more or less set its own pace in improving its manufacturing costs and it lags behind public utilities in improvement of its costs of power generation. High pressures were used as long ago as 1926, and today the use of high pressures in public utilities is the rule rather than the exception.

In 1931, a 1215 psi throttle pressure condensing turbine generator, with a total generating capacity of 110,000 kw, was installed in the Ford Motor Company's River Rouge plant. It was not until 1936 that the Ford Motor Company installed a second 110,000 kw condensing unit for operation at 1215 psi; and River Rouge has now an installed capacity of 345,000 kw operating at 1215 psi. Although the load of the River Rouge plant is widely diversified, only a fraction of it is being used for blast furnace power, the plant is cited here as the beginning of the trend to higher pressure for steel mill power.

It is believed that the first high pressure installation, made strictly for steel mill power, was a 10,000 kw, 800 psi gage throttle pressure, 250 psi gage back pressure turbine generator, which was constructed in 1936 for the Weirton Steel Company. There is today a total of 25,000 kw of installed capacity in United States steel mills operating at 800 psi to 850 psi, and a total of only 103,000 kw of installed capacity in steel mills generating at pressures of 550 psi to 650 psi. Table I gives a list of high pressure installations existing in the steel mills of this country that are known to the author. The total generating capacity of the high pressure plants, exclusive of River Rouge, is less than 130,000 kw.

Published information makes it unnecessary to set forth here, statistics of public utility and industrial power plants using higher pressure. It should suffice to say that public utilities generally find it uneconomical to install new steam electric generating plants for operation at pressures below 500 psi. While each proposed installation requires individual study for integration with existing installations into a plant adaptable to change, as may be required by a positive long range program of development, it is difficult to discover any economic justification for the exclusive use of low pressure steam in new or rehabilitated steel mill power plants.

It should be pointed out that although some industrial plants demonstrate practical applications of high pressures and temperatures, the average industrial plant is no criterion for the design of steel mill power plants. Industrial plants frequently use large amounts of steam extracted and exhausted from turbine genera-

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tors at low pressure for process. The steel mill, in contrast, may use most of its steam generating capacity for generation of power, as does the utility plant.

In industrial plants, turbine heat cycle efficiencies are not the major concern. Provided that the heat in exhaust is fully utilized, the efficiency of a cycle is always 100 per cent. The actual heat cycle efficiency is as close to 100 per cent as mechanical, electrical and radiation losses will permit. This is true for any initial or final pressure and temperature. The water rate of the prime mover is as important in the industrial plant as in the steel mill, not because a low water rate saves fuel, but because it permits the generation of more power from a given quantity of steam. Mechanical, electrical and radiation losses are of more importance in an industrial plant than in the steel mill.

Certain other losses, for instance leakage past turbine blades, while objectionable because they reduce the amount of power available from a fixed quantity of steam, are less vital than in the steel mill, because all heat which is not converted into useful work or lost in radiation and friction, is delivered to industrial process in the exhaust steam. In a steel mill power plant, the heat cycle should provide the lowest possible water rate to permit the maximum generation of power from a given quantity of steam.

Low operating pressure in any steam electric generating power plant results in a poor heat cycle efficiency and the use of an excess of fuel. It might be argued that this is of no consequence, as steel mills producing pig iron in general have an excess of blast furnace gas, the usual fuel for boilers in steel mills. However, such argument is not consistent with sound economic thinking. Improvement in economy of operation should always be striven for, to eventuate in an ultimate saving regardless of inefficiencies existing in other phases of the manufacturing system. Any partial saving will better the overall plant economy.

Steel production economy is outside the province of this paper but must be given some consideration in planning, since steel mills themselves produce the gaseous fuels for which the boiler plant must be designed.

A steel mill, continually producing more blast furnace gas than it can use in its processes, is without doubt operating on an unbalanced heat cycle, for, although having low calorific value of approximately 95 Btu per cu ft, blast furnace gas has many uses in steel mills, being burned in open hearth furnaces, in stoves to heat air for the blast furnaces, in boilers, in gas engines and in coke ovens to produce coke and coke oven gas. The very diversity of the use of blast furnace gas should provide sufficient flexibility to avoid its waste.

For purposes of study, a steam electric generating plant for a steel mill is assumed to have a total installed electric generating capacity of 100,000 kw. Figure 1 illustrates a typical load curve of such a plant. The load may be broken down into three classes, the peak load, the load of the steel mill auxiliaries, and the load of the power plant auxiliaries, as shown on Figure 2. The peak load would consist of the loads of rolling mills and short circuit loads of arc furnaces, would be approximately 55 per cent of the total generating capacity and would exist only 15 per cent of the time. Other steel mill equipment would require approximately 38 per cent of the load which would exist 90 per cent of the time. The

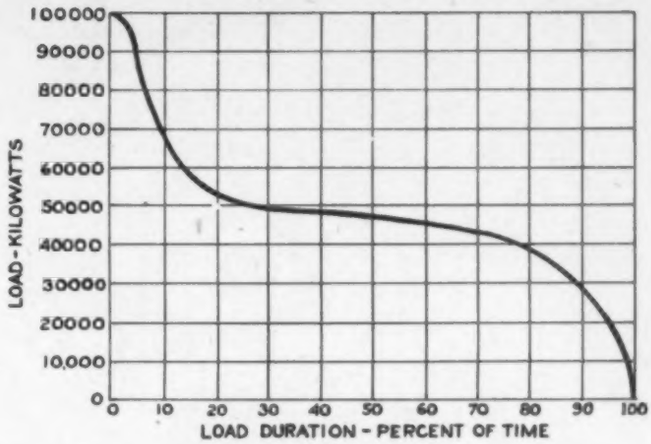


Figure 1 — Hypothetical load-duration curve for plant of 100,000 kw total generating capacity.

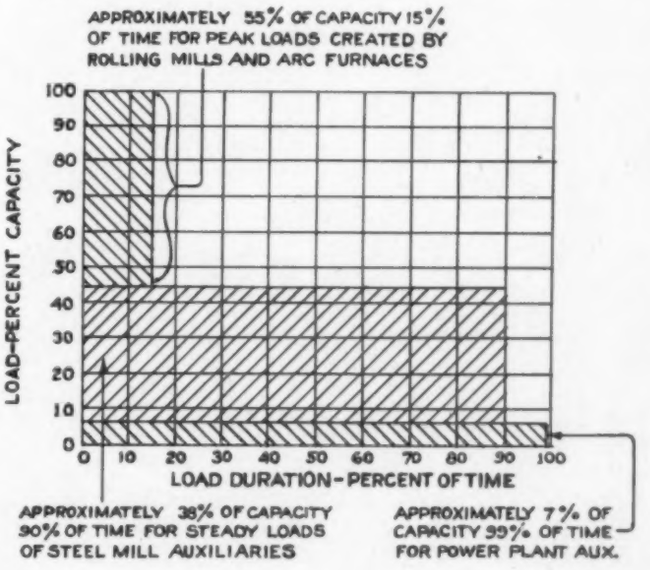
remaining 7 per cent of the load, consisting of the power plant auxiliaries, would exist 99 per cent of the time.

A major concern of steel mill power plant engineers has been the control of the widely fluctuating peak load imposed upon the mill power plant and, if connected also to an outside source of power, on the interconnected system.

Figure 3 illustrates typical load characteristics for a continuous hot strip mill. During the first 15 seconds of operation, the load jumps approximately 30,000 kw, increases slightly during the next 20 seconds as the strip travels through the mill, and drops back to idling load in about 5 seconds at the exit of the strip from the mill. The cycle is repeated approximately every 120 seconds.

Extremely difficult problems of electric load control have been encountered as a result of the loads of strip mills. Frequently, the duty imposed on the generator bus is limited by the use of flywheel motor-generator sets. However, an interesting example is that of the hot strip mill load of the Tennessee Coal and Iron Company at its Fairfield plant near Birmingham, Alabama.

Figure 2 — As shown by the graph, half the load on the power plant is required only about 15 per cent of the time.


APPROXIMATELY 55% OF CAPACITY 15% OF TIME FOR PEAK LOADS CREATED BY ROLLING MILLS AND ARC FURNACES
100
90
80
70
60
50
40
30
20
10
0
LOAD-PERCENT CAPACITY
0 10 20 30 40 50 60 70 80 90 100
LOAD DURATION - PERCENT OF TIME
APPROXIMATELY 38% OF CAPACITY 90% OF TIME FOR STEADY LOADS OF STEEL MILL AUXILIARIES
APPROXIMATELY 7% OF CAPACITY 99% OF TIME FOR POWER PLANT AUX.

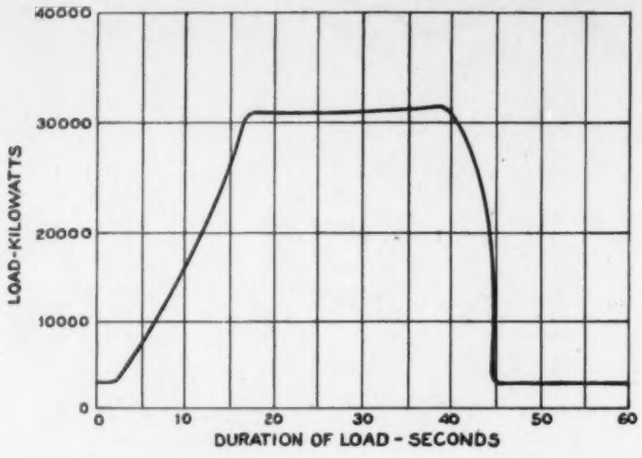


Figure 3 — The power requirements of this hypothetical hot strip mill fluctuate rapidly.

The load of the rolling mill was not carried by the steel mill power plant due to the insensitiveness of the turbine generator control, but was carried on the Alabama Power Company system which ties in to the Commonwealth and Southern, and TVA power systems. The magnitude of the fluctuations were such as to affect the load dispatching through the whole southeast power grid, and it became necessary to carry peak loads on the steel mill power plant to minimize demand charges for purchased power.

A control system was developed which increased the speed of response of the turbine valve gear so that the steel mill power plant took over enough of the load peaks to prevent any serious disturbance to the power system regulation from that cause. This was done by using rotating regulator generators, controlled from the rolling mill motor circuits, to operate pilot motors on the turbine steam admission valves, in effect creating turbine governors sufficiently sensitive to hold most of the load fluctuations on the mill power plant.

A steel mill power plant, not operating in parallel with a utility power system and not purchasing power, would not require an elaborate system of load controls; but, if the total mill power requirements were greater than its maximum generating capacity, proper scheduling of various processes would be required. In any case, frequency regulation would be required for such a plant to avoid disturbance of the time cycles of rolling mills and other equipment, the motors of which must operate at uniform speeds for proper coordination of steps of production.

Steel mill power plant equipment should be designed to carry the peak loads occurring, and there is no question that this can be done provided the equipment is properly integrated with plant design.

Turbine generator manufacture has developed to a point where any problem of load fluctuation encountered in the steel mill may be solved; and control of wide load fluctuations, particularly in boilers, is greatly facilitated by high pressure.

In the utility field, there are high pressure boiler installations which operate with variations in load, as great as from 10 to 100 per cent, which take place in an interval of 4 to 5 seconds. Some of these boilers are of special design with large water storage spaces which act like accumulators. This permits almost instantaneous flashing of this water into steam with a minimum boiler drum pressure drop to provide for momentary demands until such time as fuel and air supplies for combustion can be increased to meet the demand. Steam drums of the boiler must be large enough to accommodate these surges which occur with the flashing of steam, and a suitable steam purifying system should be provided for the prevention of carryover. Unobstructed circulation of water in the downcomer tubes of the boiler is required to maintain a unidirectional flow of water when bubbles of flashed steam are formed.

Boiler manufacturers are equipped to design high pressure boilers for operation in plants subjected to sudden changes in load. The speed of response of automatic combustion control equipment has been markedly improved in recent years, and manufacturers of auxiliary equipment are capable of designing and producing equipment for satisfactory operation well within the allowable swings of a boiler.

The high pressure boiler at the Carnegie-Illinois Steel Corporation's Rankin plant, having a capacity of 450,000 lb per hour of steam at 600 psi gage, 750 F, was designed for violent load fluctuation. The Rankin plant contains six large blast furnaces and produces a large surplus of blast furnace gas, the supply of which fluctuates and is subject to interruption hazards. Pulverized coal firing facilities capable of handling full boiler capacity had to be provided in addition to the gas firing equipment.

In designing the combustion control system of this plant, to make the most economical use of the fuels provided, and at the same time to meet any load fluctuations placed upon it, preference was given to the use of blast furnace gas to the maximum extent that it was available, and that fuel was supplemented with pulverized coal where necessary.

These two fuels require different quantities of air for combustion and produce radically different quantities of combustion products. Consequently, it was necessary that the combustion control equipment be capable of varying the air supply, not only with load changes, but also with changes in fuel proportions. Furthermore, it was necessary to design the pulverized coal equipment to pick up the load in the event that unexpected reductions or complete failure in the gas supply should occur at times when the entire load was being carried by blast furnace gas.

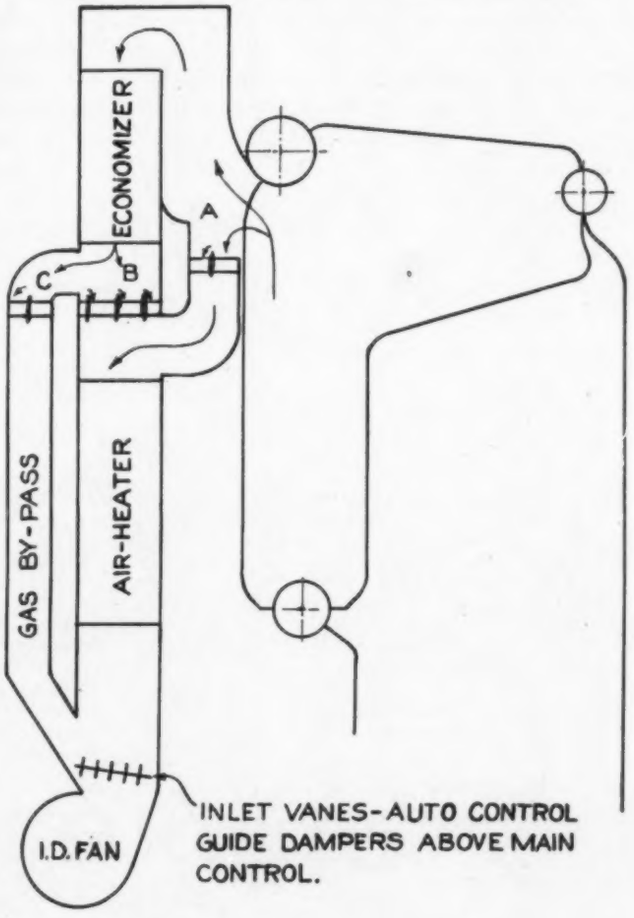
The problem of handling great quantities of combustion products formed when blast furnace gas is burned becomes increasingly important with large boilers having extensive heat recovery equipment. Huge quantities of gas result in high draft losses, which in turn necessitate large induced draft fan capacity and high power consumption. To reduce the draft loss through the boiler when fired with blast furnace gas at high loads, and correspondingly, to reduce the size as well as the power consumption of the induced draft fans, especially designed automatically operated dampers were provided to control the flow of gases through or by-pass them around the economizer and air heater, as shown in Figure 4.

If relatively small quantities of flue gases are being

produced, dampers A and C are closed, damper B is wide open, and all products of combustion pass through both economizer and air heater for maximum heat recovery. When the load increases, the controls operate a regulator which begins to open damper C, and consequently permits part of the gases to by-pass the air heater. Further load increases open damper C wider, until it has been opened its limit, then two additional regulators begin to open damper A and close damper B to by-pass the economizer. During this process, as the load increases to a maximum, damper B is only partly closed as damper A opens, maintaining a slight differential pressure that prevents by-passing the air heater also.

Several large public utility steam plants in California have been built and others are in the process of design and construction, which serve large systems ordinarily supplied from hydroelectric plants through extensive transmission systems. Since these supplies are subject to sudden unpredictable interruptions, these new steam stations, now in the design stage, must be capable of immediately increasing their power output from spinning reserve or stand-by conditions to maximum output in the event of such interruptions. This means increasing a station output from, say, 8000 or 9000 kw to 160,000 kw in about 20 seconds. One of these plants will have a 60,000 and a 100,000 kw unit, each of which will operate at 1350 psi gage and 900 F at the turbine throttle. Another will have two 60,000 kw units to operate at 850 psi gage and 900 F. Also, several papers

Figure 4 — Automatically operated dampers control flow of gases through the economizer and air heater.



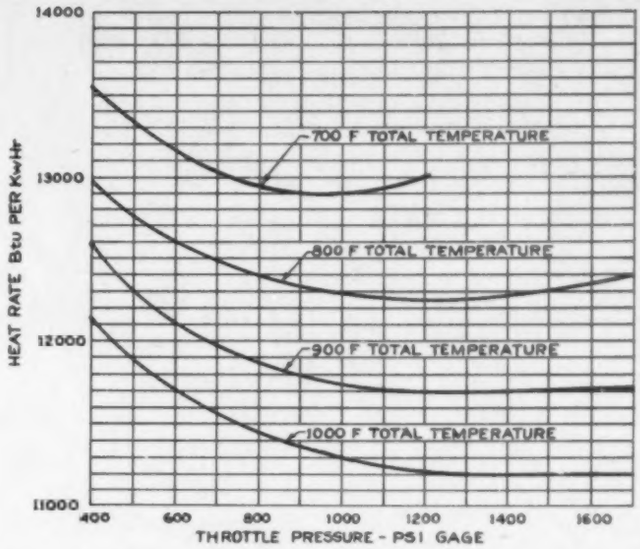


Figure 5 — This graph shows practical, overall heat rates for fixed conditions of pressure and temperature.

have been presented recently describing actual operations where similar load increases have been successfully handled.

It is expected that steel mill load variations would be less severe and that the steel mill power station operators would have the advantage of knowing approximately when wide fluctuations might occur, whereas the utility stations must be ready to carry these load increases without previous warning.

An elementary study of practical, attainable overall plant heat rates is illustrated by Figure 5. For simplicity of comparison, the study is confined to the fixed conditions of 335 F feed water temperature, 3 stage extraction and 1 in. mercury absolute exhaust pressure while throttle pressure and temperature are varied. Operating economy of high pressures is naturally a matter of specific study of a particular plant.

A steam electric generating plant operating at 400 psi gage, 750 F throttle pressure and temperature might have a heat rate of approximately 13,225 Btu per kwhr. By increasing the pressure and temperature to 800 psi gage, 900 F, the heat rate would be reduced to approximately 11,875 Btu per kwhr to result in a saving of 10.2 per cent in the amount of fuel burned. By increasing the pressure and temperature to 1200 psi gage, 900 F, the heat rate could be reduced to approximately 11,710 Btu per kwhr, to result in a saving of 11.6 per cent in the amount of fuel burned.

A 1000 ton blast furnace produces approximately 70,000 cfm of blast furnace gas, having a total calorific value of 6,650,000 Btu per min or 399,000,000 Btu per hour, equivalent to 30,150 kwhr of power generation based on a power plant heat rate of 13,225 Btu per kwhr when operating at 400 psi gage and 750 F.

To generate 30,150 kwhr in a power plant operating at 800 psi gage and 900 F with a heat rate of about 11,875 Btu per kwhr, only 62,800 cfm of gas would be required, leaving available more than 10 per cent of the gas for other uses. A steel plant with five 1000 ton blast furnaces might produce approximately 350,000 cfm of blast furnace gas. The same steel mill might have a power plant with total generating capacity of

100,000 kw. At 400 psi gage pressure, 750 F temperature operation and full load of 100,000 kw, the steam electric generating plant would consume approximately 232,500 cfm of blast furnace gas, leaving available for the steel mill process approximately 117,500 cfm. At 800 psi gage pressure, 900 F temperature operation, the plant would burn 209,000 cfm of gas, leaving available 141,000 cfm of gas. At 1200 psi gage pressure, 900 F temperature operation, the plant would burn 205,600 cfm of gas, leaving available 144,400 cfm of gas.

The possibilities of such savings should not be overlooked in the steel industry's increasing competition with the light metals industry and the plastics industry.

Of the 243 odd blast furnaces in this country, there are not more than 35 or 40 furnaces operating with gas engine driven blowers, and there is only one blast furnace with a motor-driven blower. Although the reciprocating steam engine driven compressors are still used in the majority of blast furnace blowers, their high maintenance costs are causing them to be displaced by turbine driven blowers. Steam turbine drives provide the necessary speed control and reliability required for the continued supply of air to blast furnaces. In the past, steam turbine drives for blast furnace blowers have been designed for pressures up to 450 psi gage throttle pressure, with impulse blading and stiff shafts for operation at speeds below critical.

Impulse blading provides necessary clearance for severe conditions of operation, and stiff shafts have been considered essential because of wide speed range. It is unlikely that stiff shaft turbine drives for blast furnaces will be available in the immediate future for operation at throttle pressures in excess of approximately 600 psi gage since, with higher pressures, more stages on a longer shaft are required, resulting in a turbine with low critical speeds. The steam conditions required for blast furnace blower turbine drives should not present a great heat balance problem as the steam consumption of these drives would not be more than 30 per cent of the total steam generating capacity of a plant.

The selection of the main condensing turbine generator operating pressure should be governed, within limits, by the AIEE-ASME preferred standards for turbine generator design, as the new standard machines will have lower first costs than tailor-made units.

In the mills of the three dozen or more steel companies operating blast furnaces in this country, the power plants operate at low pressure and temperature, and must therefore be operating with poor fuel economy with high heat rates. The largest plant of gas engine driven generators operates with a heat rate of approximately 15,880 Btu per kwhr. In the same steel mill, the turbine generators, using steam from waste heat boilers, operate with a plant heat rate of approximately 13,340 Btu per kwhr; and the blast furnace, gas fired, 400 psi gage, 750 F steam electric generating plant operates with a heat rate of approximately 13,600 Btu per kwhr, indicating that a high pressure steam station would be more efficient than any of these. The diversity of the peak load power consumption of a steel mill vitally influences future development of a steel mill power plant operating with heat rates such as these. The overall cost of operating existing old and inefficient equipment for short periods may be less than the cost of installing and operating new and more efficient equipment. It is rarely found economical to replace existing equipment on the basis of improved efficiency only. However, it is axiomatic that when new and more efficient equipment is installed, it should be used to carry the base load and that the less efficient equipment be operated to carry the peak loads, in so far as reliability allows.

A new power plant or an extension to an existing power plant should be designed to produce the required steam and power at the lowest total annual cost. This total includes operation, maintenance and fixed charges. The fixed charges for a high pressure steam station would, of course, be greater than those for a low pressure steam station having the same net output capacity. Maintenance charges might be slightly higher for the higher pressure plant as compared to the lower. Operating charges, however, for the high pressure plant would be smaller, due to the thermal or heat cycle savings obtained. It has been demonstrated that the operating savings for pressures of 900 to 1500 psi outweigh the other charges in the public utility field. It is reasonably certain that such pressures would also result in a net saving in the steel industry, particularly

TABLE I

High Pressure Turbine Generators in American Steel Mills

Date	Company	Location	Number of units	Total capacity kw	Type	Throttle pressure psi	Throttle temperature F	Back pressure psi	Make
1931	Ford Motor Company	River Rouge, Michigan	1	110,000	Condensing	1215	750	....	General Electric
1936	Ford Motor Company	River Rouge, Michigan	1	110,000	Condensing	1215	910	....	General Electric
1939	Ford Motor Company	River Rouge, Michigan	1	110,000	Condensing	1215	910	....	General Electric
1939	Ford Motor Company	River Rouge, Michigan	1	15,000	Back pressure	1215	910	250	General Electric
1936	Weirton Steel Co.	Weirton, West Virginia	1	10,000	Back pressure	800	800	215	General Electric
1940	Weirton Steel Co.	Weirton, West Virginia	1	10,000	Back pressure	600	800	225	Allis-Chalmers
1939	Bethlehem Steel Corp.	Lebanon, Pennsylvania	1	3,000	Back pressure	650	750	150	General Electric
1945	Bethlehem Steel Corp.	Lackawanna, New York	1	7,500	Back pressure	850	850	265	General Electric
1941	Carnegie-Illinois Steel Corp.	Rankin, Pennsylvania	1	40,000	Condensing	550	750	....	Allis-Chalmers
1943 1944	Carnegie-Illinois Steel Corp.	Braddock, Pennsylvania	2	25,000	Condensing	650	750	....	Allis-Chalmers
1945	Republic Steel Co.	Youngstown, Ohio	1	7,500	Back pressure	850	850	210	General Electric
On order	Youngstown Sheet & Tube Co.	Indiana Harbor, Indiana	1	10,000	Back pressure	800	750	200	Westinghouse
On order	Bethlehem Steel Corp.	Sparrows Point, Maryland	2	60,000	Condensing	850	900	....	Westinghouse
On order	Weirton Steel Co.	Weirton, West Virginia	1	25,000	Condensing	800	800	....	Westinghouse

if applied to the base load, when older and less efficient equipment is serviceable for carrying the peaks.

Other possible advantages of high steam pressure include the reduction in quantity of condenser circulating water, if there is any limitation on the amount of cooling water available for the steel mill. Noncondensing turbine generators may be installed similar to those shown in Table I, which would permit continued use of existing low pressure condensing turbine generators that may have many years of useful life, whereas the corresponding low pressure boiler plant equipment may be worn out or in such condition that it would require excessive maintenance.

The cost of operating labor has been increasing to such an extent that existing low pressure stations should be studied to determine whether a few large boilers might be installed in place of many small ones, to decrease annual operating labor costs. It is possible that the combined savings of higher pressures and such lower labor costs might justify replacement of existing low pressure equipment that otherwise might have been considered satisfactory for continued use.

It is recommended, therefore, that existing low pressure steel mill power plants be investigated carefully to determine whether a partial or complete replacement by modern high pressure equipment can be economically justified, and wherever additional capacity is required that high pressures be used.

The annual load factor of the proposed new plant has been shown as approximately 50 per cent on Figure 2. If a 30 per cent load factor were expected as an average over the life of the equipment, there would be less operating saving possible between the low and the high pressure plant, so that load factor has to be established to design the station properly. However, if older equipment can carry all or most of that 15 per cent of short duration load shown on Figure 2, then the load factor on the new installation may be about 80 to 85 per cent, and the savings due to higher pressure would be correspondingly greater.

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DISCUSSION

PRESENTED BY

JULIUS H. STRASSBURGER, Manager, Department of Service and Maintenance, Weirton Steel Company, Weirton, West Virginia

JOHN G. GREENWOOD, Steel Mill Section, General Sales Department, Ingersoll-Rand Company, New York, New York

Julius H. Strassburger: At Weirton we have had an 800 psi, 800 F turbine plant in operation for somewhat over ten years. Our first two boilers and turbine went into operation in July, 1936. The turbine was a topping type unit with 225 psi back pressure. In 1940 an additional third boiler and a second topping turbo-generator were installed. These two turbo-generators are rated at 10,000 kw, at 0.8 power factor.

In 1947, we are going to place into service a 25,000 kw, 80 per cent power factor machine with a fourth high-pressure boiler.

We have accumulated some data on the availability of our 800-pound boiler and turbine equipment over a ten year operating period. Some of the high points are as follows:

The No. 1 boiler, which was started in July 1936, has been installed for somewhat over 89,000 hours. It has been off the line a total of 5865 hours, and there has been a net availability of 93½ per cent in ten years and two months of operation.

The No. 2 boiler, which was started about a month sooner, June 9, 1936, has been installed for somewhat over 90,000 hours, has been off the line 5348 hours, with a net availability of 93.9 per cent.

The No. 3 boiler, which was put on the line in December, 1940, or close to six years ago, has been installed for about 60,000 hours, has been out of service 2420 hours, with an availability of 95.9 per cent.

The complete availability of the three boilers since their time of installation is 94.3 per cent.

Tables II and III give some of operating experiences with our turbines. As far as the availability of the turbo-generators is concerned, the original 10,000 kw back pressure machine, which was installed and started in operation in June of 1936, has been installed for 89,472 hours. It has a net availability on the line of 97.38 per cent. That includes all time out for inspection, wash-outs and any steam line repairs, etc., that cause a shut-down of the turbine. This machine, which is rated at 10,000 kilowatts, has averaged 10,110 kilowatt hours for every operating hour it has been on the line since installation. It is being operated as a base-loaded machine.

The second 10,000 kilowatt unit, which was placed in operation in December, 1940, has operated close to 50,000 hours, has had a net availability of 97.17 per cent. This machine has averaged 8362 kilowatt hours for every hour it has been on the line.

The difference between the two machines is that the second machine is being operated on back pressure,

TABLE II

Availability of No. 6 Turbine Steel Works Power House

	Installed hours	Operating hours	Wash-outs	Wash-out hr	Washout per cent availability	Repair hours	Repair per cent availability	Total hr loss	Total per cent availability	Hours unavailable	Kw hr generated X 1000
1936	4,752	4,683	....	....	100	69	98.55	69	98.55	....	42,858
1937	8,760	8,607	6	49	99.44	104	98.82	153	98.26	....	79,790
1938	8,760	8,277	6	59	99.33	424	95.16	483	94.49	....	76,819
1939	8,760	8,651	6	56	99.36	53	99.40	109	98.76	....	90,871
1940	8,784	8,673	6	55	99.37	56	99.37	111	98.74	....	92,857
1941	8,760	8,588	7	73	99.17	99	98.87	172	98.04	....	74,510
1942	8,760	8,621	6	68	99.22	71	99.19	139	98.42	....	85,836
1943	8,760	8,653	3	32	99.6	40	99.54	107	98.7	35	89,694
1944	8,784	7,939	1	7	99.92	820	90.64	845	90.53	18	87,674
1945	8,760	8,650	4	49	99.44	58	99.34	110	98.7	3	95,322
1946	5,832	5,786	2	24	99.59	22	99.62	46	99.21	....	64,711
TOTAL	89,472	87,128	47	472	99.47	1816	97.97	2344	97.38	56	880,942

The above figures represent an average of 10,110 kw hours generated per hour.
All figures are based on period from date of installation — June 16, 1936 to September 1, 1946.

TABLE III

Availability of No. 7 Turbine Steel Works Power House

	Installed hours	Operating hours	Wash-outs	Wash-out hr	Washout per cent availability	Repair hours	Repair per cent availability	Total hr loss	Total per cent availability	Hours unavailable	Kw hr generated X 1000
1940	96	80	....	....	....	16	83.0	16	83.0	....	324
1941	8,760	8,531	....	....	....	229	97.38	229	97.38	....	80,581
1942	8,760	8,627	....	....	....	133	98.48	133	98.48	....	63,183
1943	8,760	8,728	....	....	....	32	99.63	32	99.63	....	69,115
1944	8,784	7,981	....	....	....	803	90.86	803	90.86	....	69,460
1945	8,760	8,662	1	16	99.82	60	99.31	98	98.88	22	75,505
1946	5,832	5,736	1	18	99.69	37	99.36	96	98.35	41	46,098
TOTAL	43,752	48,345	2	34	99.93	1310	97.38	1407	97.17	63	404,266

The above figures represent an average of 8,362 kw hours generated per hour.
All figures are based on period from date of installation — December 28, 1940 to September 1, 1946.

swinging with the load, while the other machine has for the major part of the time been operated base load.

As Mr. Sawyer stated in his paper, it is logical as more efficient equipment is installed in a given plant, to operate the newer equipment at a high base-load. When our new 25,000 kw turbo-generator is installed, it is our plan to operate this unit as a base-load machine at about 28,000 to 30,000 kw.

The boilers are scheduled at the present time to operate 90 days, with a four-day period for cleanup and washout, both external and internal. When the fourth boiler is installed next year, we expect to extend the operating time to 120 days, with a four-day cleanup, thereby increasing the availability of the boilers. We feel that with the improved feedwater equipment that is being installed and with the fourth boiler on the line, we can extend the operating period.

Mr. Sawyer mentioned the flashing of steam from the steam drums in fluctuation of the steel mill controls. We feel that is very important. Our high-pressure boilers are four drum bent tube so with three boilers we have nine steam drums and we can take fluctuations of 20,000 to 30,000 kilowatts instantaneously, and the steam drums have sufficient capacity to carry the fluctuation until the automatic boiler control can pick it up.

It is our opinion that high pressure boilers are more easily operated than the old 225-pound boilers.

John G. Greenwood: Mr. Sawyer mentioned that impulse turbines with wide clearances and stiff shaft are not available for steam above 600 pounds. I believe that turbines can be built for higher pressures. However, I would like to point out that with an impulse turbine, in order to utilize the heat drop in the high-pressure, high-temperature steam, additional stages must be added. This in turn makes it harder to build the stiff shaft unit. I believe that most operators would elect to settle on a stiff shaft turbine, because the blast furnace blower service is so rugged, not only due to sudden load changes but also due to speed changes.

In cases where high-pressure, high-temperature steam have been considered in the past, they have, generally speaking, elected to top the moderate temperature system with base load generator units.

Storage Yard Materials Handling

. . . . it is much faster and more economical to move words and records than to move heats of steel . . . . the storage plan described is based on this principle, and the extra clerical work required for storage control is saved many times over by the decrease in physical handling . . . .

By FRANK C. WIER

Superintendent of Labor and Yards

Timken Roller Bearing Company

Canton, Ohio

▲ THE handling of storage items in large steel mill units is usually an engineering problem solved by permanent installations for each commodity, such as conveyor belts, bins, and ore bridges. They are quite successful in providing low cost, dependable service.

Smaller steel mill units have an equal number of commodities but do not have quantities which justify major installations for each. In fact, alloy steel producing mills have not only a larger number of items but in addition also have a very exacting scrap segregation and classification program. These conditions require a storage yard layout providing very flexible handling facilities and accurate inventory controls.

This type yard will be discussed in this paper. It is located at the Gambrinus plant of The Timken Roller Bearing Company, Canton, Ohio. It serves both the Canton and Gambrinus plants of the Steel and Tube Division.

Because of production demands brought about by war conditions, it was impossible to provide additional building space necessary to handle excess raw and semi-finished materials generated by peak production.

Our manner of satisfying this condition was to move outside all such materials that would stand weather conditions, and also to draw into one storage yard the excess of all producing departments, placing the responsibility of handling, storing and re-loading these materials under the direction of one material handling unit. This necessitated very close cooperation between storage yard and the operational units which it serves. Although the yard itself is served by mobile equipment, it has been found to be more efficient to bring the material to the yard than to send the mobile units to various working places throughout the plant because mobile lifting equipment is idle when moving. No operation is delayed by moving excess material.

On adoption of this procedure, operating departments discovered that being relieved of the unwanted detail of handling their excess materials allowed them to devote more energy to producing problems. Our experience with the plan proved that these methods are equally valuable in peactime operation as well as under war conditions. The increase in producing department efficiency, brought about by orderly, uncrowded, departmental conditions, more than pays for any additional transportation and handling required.

Delivery to the storage yard is made by the plant railroad system. All inbound cars are accumulated in the classification yard. While there, the scrap, or other material, is inspected, samples taken and classification made by the scrap inspector. All questions relative to quality, size, alloy content, or usability of incoming material are resolved before cars are consigned to the storage yard. Any doubtful material is accepted or rejected by the melting superintendent and the purchas-

Figure 1 — Aerial view of storage yard of the steel and tube division of the Timken Roller Bearing Company. This yard serves both the Canton and Gambrinus plants

Presented before AISE Annual Convention, Cleveland, Ohio, October 3, 1946

ing department. After proper clearance is made car numbers, and a description of the contents are furnished to the storage yard foreman by the scrap inspector. The storage yard foreman orders the cars to the storage yard in the sequence in which he is best able to handle them. No cars are delivered to the storage yard until they are requested. This is most important, since any other method would completely upset and congest the functions of the storage yard equipment.

Figure 1 gives an aerial view of the yard. In redesigning the yard it was decided to use a layout of multiple, single tracks connected where possible at both ends. Although a double track system is more efficient in some cases for locomotive crane use, we could not justify the track expense in our operation. Movement to another part of the yard is usually necessary after loading or unloading one or two cars at a given spot.

Within the storage yard, all the car shifting required is done by locomotive cranes. Two diesel-driven units of 25 ton capacity form the backbone of the handling equipment. One crawler type crane is used as a stand-by unit or in addition as the amount of work warrants. All three cranes are magnet equipped, powered by separate gasoline driven generator units. All three generator units are interchangeable to any crane. Cable and chain slings are used for unloading bales of tubes and bars. Clam shell buckets are available but are seldom used. A heavy crawler type tractor equipped with a front end bucket of two or four cubic yard capacity does the work formerly done with clam shell buckets.

Supervision consists of a general foreman working under the direction of the superintendent of labor and yards. A turn foreman is in direct charge of each turn. At the end of his turn he leaves the incoming turn foreman a complete written line-up of all work ahead of the yard at that time. Sequence of the work as directed by the general foreman is indicated in the written line-up. The ground man for each crane furnishes the storage yard office, at the end of each turn a written report of work done by his crane. The office clerks work from these reports to keep the inventory up to date each day. Weights come from our railroad yard office. All cars, including intermill cars are weighed in and out of the storage yard.

Maintenance of equipment is supervised by a head mechanic. He has a helper on each turn. All repairs are made at the storage yard with assistance from other departments called in as required. All units are lubricated by the operators at the start of each turn.

Figure 2 — A tractor with a front-end bucket is used for unloading bulk materials.

Figure 3 — A tractor with a front-end bucket has been found more effective in handling frozen materials than a clam shell.

Bulk materials stored in this yard are iron ore, flux stone, fluor spar, coke breeze, raw dolomite and buckwheat coal. These materials are grouped together in a part of the yard created for this purpose.

Scrap in its various forms occupies the greatest yard area and also requires most of the yard work. A preparation of certain forms of our own processing scrap is carried on here.

Blooms with a few ingots and billets are given another yard section in order to facilitate locating heats for reloading.

Tubes and bars are handled by a different method than other semi-finished steel so they are grouped together in their own yard section.

Spare parts and idle machinery could be dispensed with entirely if left to the yard men but not from the viewpoint of the various maintenance departments. Both sides of one track for a distance of 400 feet are devoted to this storage.

Figure 2 illustrates our method of unloading bulk materials. Some time ago, iron ore to be stocked at the yard arrived in gondola cars. A locomotive crane and clam shell bucket was used for this unloading. This type of car caused considerable difficulty as ore routed directly to the stock house had to be shipped in cross-bottom hopper cars. It was very difficult to schedule the arrival in our plant of the right kind of car equipment to suit the need of the moment. As a clam shell bucket can only work on the top of a pile of frozen ore, a very troublesome condition arose each winter. Cold weather loading was very slow and costly. The opening made one day was frozen hard again a few days later. These difficulties caused us to seek a method whereby cross-bottom hopper cars could be used at both places and we could reduce the bucket abuse caused by the frost. The problem was solved by the use of a heavy crawler-type tractor equipped with a front-end bucket. A section of track was elevated on an earth fill at a 3 per cent grade. It levels off at eleven feet above the ground for a distance that will hold five cars. Under the car nearest the grade is a concrete pit twelve feet wide. Bulk material dumped from the cross-bottom hopper cars into this one pit is picked up by the bucket on the front of the tractor and carried to its respective pile. Although iron ore was the commodity that caused

the setup to be made, it works as well for any other bulk material that can be stored outside. There is no trackage limit to the amount of material that can be stored by this method. A two cubic yard bucket is used for iron ore, fluor spar and flux stone. Lighter materials such as coal and coke are handled with a four cubic yard bucket.

Reloading is accomplished by means of a low ramp at an adjacent track, the ramp being just high enough to give the tractor bucket sufficient clearance to dump into a hopper car. See Figure 3. Frozen ore is not a great problem to load with this equipment. When the crust of frost is broken in one place, the forward power of the tractor plus the lift of the bucket as applied from below is much more effective than working from the top of the pile with a clam shell bucket.

This tractor can and has been used to load scrap from stock piles into gondola cars. It can load a car of scrap in less time than a locomotive crane with a magnet but it is not a recommended practice. To avoid loading slag or dirt, a layer of scrap must be left to be cleaned up later. We use it for this work on an emergency breakdown basis only. By the same token some part of each pile of bulk material is accessible to a track so that in case of a tractor breakdown, the material can be loaded by clam shell bucket with a locomotive crane for the period of the emergency.

The purpose of this bulk material yard as related to iron ore is to stock enough during the lake season to last through the winter until the boats resume in the spring. The stock of other materials is calculated to take care of irregularities in delivery only. The regular flow is directed to the melting department. The storage yard takes the overage or meets the shortage as occasion demands. The use of the tractor bucket for this work is very irregular. Spare time is used stocking coal at the boiler house and doing many and various digging and earth moving jobs about the plant.

Figure 4 illustrates the first step in scrap preparation and shows the sorting of scrap tubes for alloy types. Scrapping of semi-finished tubing occurs during various operations of finishing and in several different departments. A tube here and one there from many orders of varying types of steel dropped into the same scrap bucket presents a hodge podge of scrap types. Over the years this presented a problem in type segregation. Upon completion of a modernized storage yard, the entire problem, as well as the scrap tubes of many colors, were sent there. It was soon found that if the producer of the scrap would properly and securely wire this

Figure 4 — Scrap sorting is a very essential step in an alloy mill.

Figure 5 — Scrap shearing is so scheduled that the shear will operate several turns on one kind of scrap.

material into tight bundles, they could be unloaded from the cars by magnet in a very short time. The first cars, loaded with the idea of merely getting rid of the stuff took several crane hours to unload. When the scrap comes in a properly bundled condition, twenty minutes is usually enough time for unloading it.

The separating table with divisions for each of ten kinds of alloy scrap is purely the child of necessity. The scrap tubes came too fast to allow for proper engineering design as the table plainly shows. It is built almost entirely of scrap rail. A full carload of tubing can be placed on the table at one time. This capacity liberates the attending crane for other work about half the time the table is in use. During the war, when labor was short, some accumulation occurred at this point. Soon we expect to be in a position to separate all incoming tube scrap as it arrives, taking it directly from the cars to the table. As the bales of separated scrap tubing are taken from bucks of the table, they are stocked ahead of the scrap shears in piles according to type of steel.

Enough of one type of tube scrap is accumulated ahead of the shears to provide work for several turns. In this fashion a minimum amount of crane service is required in front of the shears in loading the prepared material. In a run of this kind of scrap, tubes of all sizes are stocked on the shear table. The table will hold about fifty tons. The shear, being a closed type, in which the material is fed end ways by means of rolls, will take up to a five inch tube. All tubes larger than that are thrown out by means of a sloping roller table behind the shear feed rolls. This results in a stock of large tubes over five inch diameter, all of the same scrap type, being accumulated during the run. Due to their large size, they handle well with a magnet in loose form. At the end of the run these large tubes are returned to the shear feed table. A short top blade is installed in the shear. Although the blades will not close on the down stroke the shearing action is satisfactory due again to the large size of the tube. In this manner all tubes up to seven inches are sheared. Again, all oversize tubes are thrown out the back on the sloping roller table to be burned to length. By the use of a gage the shear is allowed to remain in gear all the time. This increases production greatly over the regular method of tripping the foot pedal for each cut. The gage is set for pieces thirty inches long. This makes scrap that will handle well and can be charged into any size furnace that is desired.

All purchased scrap railroad rail comes to the storage

Figure 6 — Flame cutting of scrap is serviced by a truck which is used for no other purpose than carrying the gas tanks.

yard in unprepared form; that is in long lengths. It also is cut to thirty inch lengths on the same shear. See Figure 5. A short top blade is used for all rail so that anything up to seven inches is sheared without any sorting for size. Rail is loaded on the shear table directly from the inbound cars without intermediate handling. The table will hold a carload at a time. The height of the shear being twelve feet from the ground, a carload or more of any material can be cut without requiring the use of a locomotive crane to take away the cut material.

In a yard where location and large working area preclude the use of a central pipe system for distribution of gas and oxygen, the handling of tanks is no doubt the principal obstruction to the attainment of volume production. By means of a yard layout which provides road as well as track access to all storage areas, we are able to use a one ton truck for hauling tanks, (Figure 6). These tanks are not removed from the truck during the time they are in use. A crew of three burner men load their truck at the storeroom and proceed to work any place in the yard. Hose and torches are also carried on the truck being changed from one tank to another until the entire load of tanks is exhausted. Empties are then returned to the storeroom and a load of full tanks taken on. This truck is used for no other purpose.

Figure 7 illustrates the method of handling non-magnetic scrap. The availability of usable skips salvaged from scrap annealing covers, reduces the difficulties of this handling to a minimum. Two of these are burned from each scrap hood before the hood is reduced to chargeable size. Hard, heavy usage does not promote a very long life but it is sufficiently long to keep enough empty skips to receive the non-magnetic scrap as it is generated in the producing departments. Once in a skip, the scrap is not removed during the handling and storing cycle. When the scrap is transferred to charging boxes in the melting department the empty skips are returned to the storage yard. From there they are sent out to the producing points as required.

Figure 7 — Non-magnetic scrap is handled in skips made from scrap annealing covers.

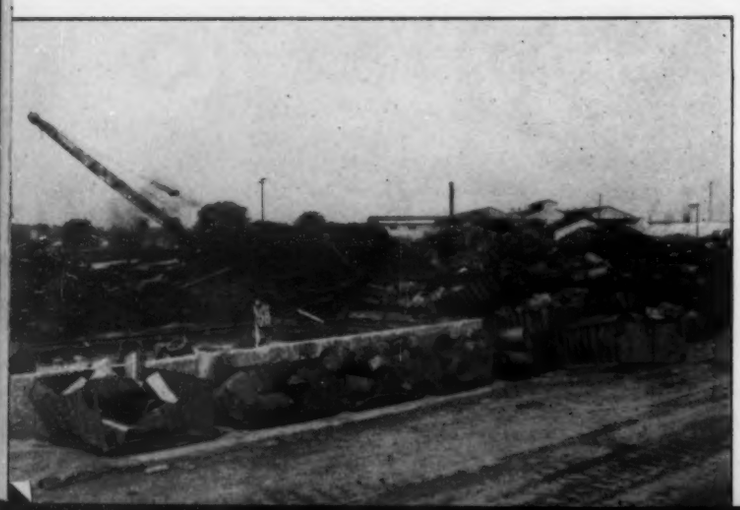


Figure 8 shows our general method of scrap piling in the yard. The electric furnace melting of alloy steel requires large quantities of scrap called "low phos" by the trade. In the main it is one foot square or less in size, and more often than is desirable, quite thin. Some years ago in our company it was felt necessary to protect this type of scrap from the action of the weather. The amount held as reserve inventory was regulated by building space. Inventories of other types of scrap were stored outside in areas which could be found adjacent to railroad tracks. The result of this practice was the loss of alloy identification and considerable mixing of alloy types. Our need for building space finally forced outside storage of "low phos." It was found that this outside storage was satisfactory, as only the exposed surface of a pile was slightly affected by the weather.

Formerly scrap was stored in large piles so that the greatest amount of scrap could be stored along a minimum footage of railroad track. Some track extensions were made from time to time until a storage area was formed. Scrap was purchased with the idea of feeding directly to the stock house and furnaces. If market conditions were favorable, an excess was placed in storage. Scrap was accumulated until it was felt that the melting operation was adequately supplied with raw materials. As scrap was drawn from storage for melting, many mixed types were found in these large piles. Melting troubles followed. High grade alloy steels cannot be melted economically from mixed or unknown scrap. It was further found that adding and taking from the same large pile of scrap made it difficult to maintain accurate inventory records, resulting in tonnage variations when any large pile was finally exhausted.

The first and most important step in seeking a remedy for these conditions was to attain a conviction in the minds of men who do the handling that the material in question has value, is of importance, and is not just so much "junk." Proper handling from a personnel angle is achieved only where physical conditions allow a good job to be done.

The yard modernization which followed was instituted principally for scrap storage purposes. Other items were added after it became evident that an adequate yard setup made economic handling possible.

In the new yard, scrap piles in general are limited to 1000 tons. When this tonnage is reached a new pile is started. If the flow of material is reversed and loading is started from a pile, no more is added to that pile. With the more active types of scrap there is usually a pile being made and another which is being depleted, both in existence at the same time. This small pile

method eliminates the necessity for year-end inventory adjustments.

Any irregularity in weight is exposed and adjusted as each pile is exhausted. This method also permits classification on a physical basis in addition to alloy type segregation. If, through an error, a mix-up should occur only a relatively small amount of scrap is contaminated with another type. The comparatively rapid pile movement allows maximum flexibility in yard capacity, since one type of scrap often dimenishes as another increases. No effort is made to pile the same type in the same spot time after time. An absolute clean-up is made when a pile is depleted. This necessitates a layer of loose material over the entire yard area. Crushed slag, 4 to 6 inches deep, is used for this purpose. Remaining loose and being porous, no water can stand in contact with the stored material. Scrap or any other material does not freeze fast in the winter. No trouble is experienced with scrap sinking into soft wet earth and even very small pieces of scrap clean up readily with the use of a magnet.

Scrap emanates from two general sources; purchased and that generated by processing. Both are routed to the storage yard. The intermill scrap is loaded into company-owned cars with a billing attached to the car as well as a copy sent to the storage yard. Enough pieces in each car are painted with a designating color to identify the type of scrap. Many cars contain two or three types of scrap. These are separated by partitions constructed of lumber. The plant railroad system moves the car to the Canton or Gambrinus railroad yard as the case may be. The yardmaster notifies the storage yard of the presence of the car. After the scrap inspector has approved the contents for application to the storage yard, he orders the car to move either directly to the stock house for melting as a part of their daily order or to the storage yard for unloading. Purchased scrap is handled in much the same manner. Although all scrap is directed to the storage yard, a great majority of it is intercepted en route and sent directly to the melting department without reaching the storage yard.

By having all scrap directed to the storage yard the general foreman there is able at all times to form an appraisal of the volume and type of work ahead. This is essential as the arrival of purchased scrap and even intermill material is subject to wide variation, and the variation must be absorbed by the storage yard.

The melting department each day places an order with the storage yard for the amount of the various kinds of scrap necessary as indicated by current melting. This order is filled during the ensuing 24 hour period. It is moved as loaded to a yard which is adjacent to the melt shop. Figuring a full stock house plus cars en route to fill their daily order, the melting department has ahead of it at all times enough scrap to last for 48 hours. By this method the melting department has only to indicate their daily need and is relieved of doing anything about the excess or shortage as the case may be.

This handling method requires a high degree of cooperation by all parties. The increased amount of detailed communication required is saved many times over by the decrease in physical handling.

Scrap stored in this yard is divided into 85 chemical or physical types. These types are carried in 14 general

Figure 8 — The various type scraps are piled in relatively small piles.

classifications. An average of 105 separate piles are maintained.

For yard and inventory identification purposes each pile of scrap is given a number of three digits. This indicates the general classification, such as heavy melt, purchased alloy, etc., as well as the individual pile number. Adjacent to each pile, Figure 9, there is placed a sign which gives the pile number, alloy type number and inventory name of the material contained in each. These are used to identify the material for the yard men when loading, as well as for inventory purposes.

The storage capacity of the yard using the piling system described is less per foot of track and less per acre of land than if large nonaccessible piles were used. Our experience has indicated however, that the merits of knowing exactly how much scrap is available and that it is all usable, as it is intended to be used, more than pays for the additional track and land required.

A physical inventory of scrap in the storage yard is taken on the first of each month. Any inventory corrections are made at that time. An inventory report is made by the storage yard office and copies furnished to interested parties. A daily report of loading and unloading in the yard is forwarded to the melting superintendent, the cost department, and the purchasing department. This report has served as a valuable aid in the control of scrap supply as it provides the scrap buyer with an up-to-date inventory at all times.

Scheduling by the production department of shipments of blooms to be moved to the storage yard is often necessary to avoid storage yard congestion, but more important to minimize the movement of material

Figure 9 — About 85 different kinds of scrap are stored in the yard.

Figure 10 — In storing blooms, careful records are kept of the blooms by heat and storage location.

and at the same time remove excess stock from the bloom or billet yards in our Canton plant. This excess varies widely in amount from time to time. A much wider scope in the scheduling of melting and rolling is afforded by having ample room to absorb excess bloom and billet inventory. Scheduling for rolling of steel placed in the storage yard is no different than that retained in the bloom yard except that 24 hours additional time is allowed by the schedule clerk for loading at the storage yard.

The easy method of storing blooms, when yard room is available, is just one heat high. This condition seldom prevails. To avoid "digging" out the bottom heat when the piles are much higher, the following procedure has been evolved. Heats selected for yard storage are classified for chemical and physical properties before being sent to this yard instead of after they are piled there. The production department advises the storage yard foreman which heats are similar and they are placed on piles accordingly. As soon as the piling is done, the yard clerk notifies the production department schedule clerk as to the piling sequence. This information being applied to his heat cards indicates which heat is on top of a given pile. Since all multiple heat piles are the same specification from top to bottom, the top heat is always scheduled first. See Figure 10.

Due to the many types of alloy steel, the cooperation necessary to effect this program is considerable, but once established it has worked smoothly. It is found much faster and more economical to move words and records than to move heats of steel.

Figure 11 illustrates our method of handling tubes and bars. Piercing and bar mills are scheduled to attain maximum production under current orders. To satisfy customer requirements it is often necessary to finish the material in smaller quantities than those which are produced on the mills. The resulting temporary excess stock is more than can be accommodated in the finishing departments. To unload all stock and reload the excess for outside storage is more than overhead cranes can handle while serving the finishing machines. The solution of the problem was found in taking all carloads of this tube and bar stock to the storage yard for unloading. It is then sent to the finishing department as their schedule requires. A small portion of the stock is moved in as it is unloaded. The major portion remains in storage from one to ten days. The movement is timed very closely. The stock is moved into the finishing department the same day schedules are issued. This method of handling provides a flow of stock which accommodates maximum finishing department production. This is not a rehandling operation. It is more a change of transport vehicle, with part of the material delayed to suit the conveniences of the receiver.

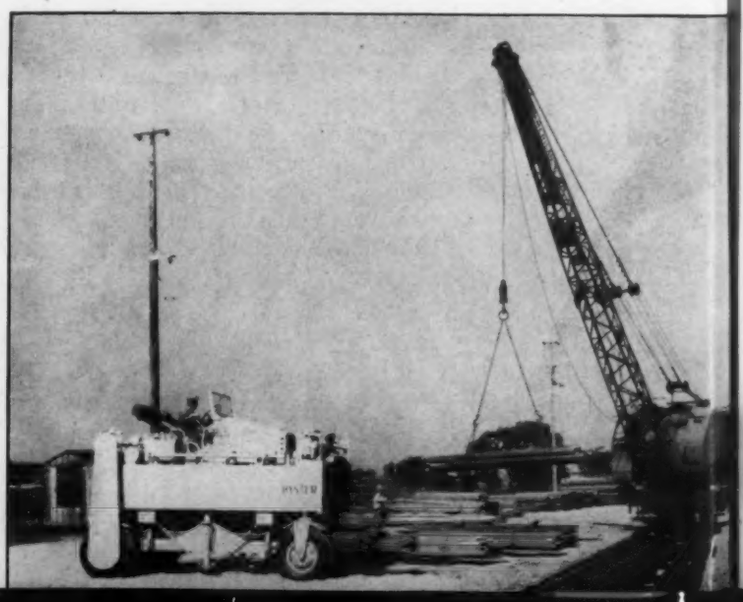
This stock is put up in bales at the piercing or bar mills where it is produced. Each bale has an attached tag recording the bale number, heat number, alloy type, and customer's name. The bales are unloaded from cars at the storage yard by locomotive or crawler crane. They are placed in lifts for straddle truck handling as they are unloaded on the ground. To suit the coming operation the number of bales in each straddle truck lift is indicated by the production department before unloading. The movement into the finishing department by straddle truck is desirable because no loading or unloading equipment is required. This is done by the straddle truck mechanism once the lift is set up.

Although spare parts and idle machinery are placed in a part of the main yard the responsibility for the contents belongs to the superintendent of maintenance. The yard organization furnishes lifting power as required. Departments planning to load equipment for this type of storage contact the storage yard foreman before loading. This prevents a loading delay if the yard is crowded with other uncontrollable work and prevents congestion.

Twice a year a yard check is made for scrap or obsolete parts. These are removed, broken, or burned and placed as prepared scrap by the yard men, after they are marked by the maintenance supervisors. This scrapping is very essential as it is very easy to send it to the dump and forget about it. For this same reason a definite limit is placed on the extent of this part of the yard.

To sum up briefly, we feel that the material handling methods developed through the use of this storage yard prove certain theories that we have long entertained:

Figure 11 — Locomotive cranes are used in the storage yard for handling excess finished tubes and bars.



1. The elimination of material congestion and confusion resulting from rehandling in the various producing departments warrants whatever outside handling, detail work, communications and attendant transportation that are required to establish the desired flow of materials through the plant.
2. Departmental excess material problems are solved to the best advantage by a storage yard whose sole purpose is to receive, store, and reload the excess materials for all departments.
3. Pride of workmanship and good housekeeping can and should be developed in handling common and less valuable materials to the same degree as that expected in more costly work.

DISCUSSION

PRESENTED BY

GEORGE S. MONKS, Resident Engineer, Jones and Laughlin Steel Corporation, Otis Works, Cleveland, Ohio

W. W. JUSTICE, Superintendent, Service Department, Youngstown District, Carnegie-Illinois Steel Corporation, Youngstown, Ohio

T. A. LEWIS, Bethlehem Steel Company, Bethlehem, Pennsylvania

G. S. Monks: Mr. Wier has described to you an ideal arrangement for the storage of reserves, surplus, or excess commodities which can be handled outside a covered building. It must be noted in this connection that the yard which he describes serves two plants producing alloy steels, and that due to the complexity of their problem, this makes such an ideal arrangement more applicable to their needs than to the simpler problem of an ordinary plant producing carbon steels. At the Otis works of Jones and Laughlin Steel Corporation, we have considerable yard space not occupied by producing departments on which we store excess commodities and spares using mobile equipment. We have a man who supervises the placing and moving from storage and makes arrangements for crane and car service. Our problem is not as complicated. Where they have eighty-five chemical and physical types and fourteen general classes of scrap, we have the following:

1. Heavy melting.
2. No. 1 bundle.
3. No. 2 bundle.
4. Pit and skull.
5. Molds.
6. Slabs.
7. Blooms.

Light sheet trimmings cannot be stored and are used as received. Our scrap is received in cars and the excess taken into storage is unloaded by magnet in the scrap yard, which is under the supervision of the open hearth, from which it can be reclaimed directly to charging boxes without extra handling or freight. This yard contains an alligator shear, a plate scrap shear and a burning crew for cutting up odds and ends of scrap which come from our own plant. Purchased scrap is prepared for open hearth charging.

Since our plant is located on the Cuyahoga river, we are able to handle ore and limestone direct from boats to the ore yard. This yard handles also the open hearth ore and limestone and the excess coke shipped in cars and stored. The open hearth ore is loaded out in gondolas, and reloaded by clam-shell buckets into charging boxes as needed. The open hearth stone is loaded into charging boxes by the ore bridge. As long as the bridge has time to do this, we see no economy in setting up a separate yard for open hearth commodities.

Coal reserves are placed in a yard and reclaimed by clam-shell buckets. Bulldozers are used to spread and pack the pile.

Excess ingots are stored in the yard and reclaimed when called for by the schedule. Excess molds, stools, spares and idle machinery are handled similarly.

While we use only steam locomotive cranes for yard service, we would suggest for anyone making changes that they use diesel type locomotive cranes thus effecting not only an operating economy but eliminating a source of smoke. In built-up communities, smoke abatement is a serious problem.

The unloading and reloading cost of freight for reserve commodities represents a large item in the operation of any plant. These costs must be weighed against the item of demurrage. Each carload is a problem in itself of how long can the car be used economically as a storage reservoir. In these days when there is such a shortage of cars they should not be used for storage and every effort should be made by the transportation department to schedule the receipt and unloading of cars in line with plant requirements so that commodities will not have to be thrown into reserve or surplus piles. When this cannot be managed, a reserve storage is a necessity and where the commodities handled are numerous, an arrangement as outlined by Mr. Wier seems to us very good.

W. W. Justice: The recognition by management that storage yard problems should be considered on a par with production problems, is probably the most outstanding thing presented in this paper. For years, the handling of miscellaneous material in steel mills has been a sadly neglected orphan. The subject matter of this paper indicates that Timken management recognized this fact a couple of years ago.

Anyone who sees this yard cannot help but appreciate that it is making money for Timken as compared to average yard practices. With continuously increasing labor rates, materials handling has developed into one of the most profitable fields of cost reduction left open to industrial management. This is particularly true in the steel industry, which has been comparatively slow in recognizing this fact.

The average industrial manager's conception of materials handling engineering covers production line conveying, pallet handling of boxes and cartons, and other of the more widely publicized handling techniques used in the automotive and electrical fields. The sooner we throw these conceptions out of the window and get down to the basic elements of all of our handling jobs, the more rapidly will we attain large reductions in cost of our products.

It would be foolhardy for anyone to establish a stor-

age yard with an organization and equipment exactly like Mr. Wier's. Unless the problems encountered are identical his set-up fits Timken's needs at Canton and it would appear that he has not been handicapped by trying to copy someone else. His solutions are unique, but they are evidence of his having attacked the problem from scratch. This is the reason his methods work. I would also like to call to your attention that this is only the beginning of an attack on handling problems in steel mills.

We at Youngstown district of Carnegie-Illinois have only started our work on these problems, but what little we have done has shown us that we are getting into a very lucrative field. We are convinced that the day of hundred man labor gangs is over. We have even been able to demonstrate that those unpleasant emergencies caused by breakouts, spills, etc., around blast furnaces and steel producing units do not require the presence of a huge pool of labor to be on tap continuously. We have found that an attack on the problem with mechanical equipment not only reduces the cost, but decreases the delays to producing units.

Any approach to materials handling problems, either in a storage yard or throughout the producing department, probably can be made in the best manner by assignment of those handling functions to a separate department with status equal to that of producing and maintenance departments. I feel that this is a major contributing factor to the success of Mr. Wier's storage yard.

I would like to ask Mr. Wier one question. Have you comparative cost statistics on your former handling costs and your present ones?

F. C. Wier: Up to the present, our cost system does not reflect material handling costs as such. Plans are being formulated to secure departmental costs which will furnish detailed information on storage yard material handling.

T. A. Lewis: In the figures was shown an elevated track. How many elevated tracks did you have for this distribution throughout the whole yard?

F. C. Wier: Just one.

T. A. Lewis: Does that cover the whole yard?

F. C. Wier: Yes, the bulk materials handled are congregated in that section of the yard.

T. A. Lewis: How many acres?

F. C. Wier: Two or three.

T. A. Lewis: Could you afford to use the bulldozer type of equipment rather than the crane type? What would be the maximum distance over which you could afford to use that type?

F. C. Wier: Three hundred feet.

T. A. Lewis: A carbon scrap plant requires considerable amount of lay down space. A considerable modification of the scheme described would be needed for the larger amounts of scrap needed in a carbon scrap steel plant.

F. C. Wier: I might explain further to Mr. Lewis that by using a tractor with a shovel front, a great amount of material can be unloaded and stored from a short length of railroad track. The material can be placed as much as 300 feet from the track and piled to a considerable height.

T. A. Lewis: In handling scrap, you indicated that you could either load or unload scrap from the car faster by that method than the method using a magnet, but you didn't advise doing it. What did you mean by that?

F. C. Wier: I mean loading only. It is, of course, physically impossible to unload scrap by that method, but we do load scrap on occasion, if we have a crane breakdown, for example. It is an emergency method only.

Mr. Monks brought out in his discussion the questionable practice of using railroad cars for storage of arriving materials.

I might explain the policy of our company. We operating men were told about three years before the war ended that there would be no more demurrage.

We operated for three years without even taking more than the free days to unload our cars. We still never go on arbitrary demurrage for any reason whatever.

Plan to Attend!

ASSOCIATION OF IRON AND STEEL ENGINEERS

Annual Spring Conference

APRIL 26 and 27, 1948

HOTEL STATLER

BUFFALO, NEW YORK

Soluble Oil
IN FLAME HARDENING OPERATIONS

. . . . soluble oil solutions are effective as a quench in flame hardening operations because of their ability to quench steel rapidly through the critical zone, as well as at a slower rate in the lower temperature range . . .

By STEPHEN SMITH
Air Reduction Sales Company
New York, New York

▲ NEW processes require new materials and the establishment of new procedures. Ox-acetylene flame hardening, being a comparatively new addition to the heat treating industry, is constantly introducing new techniques. In the general field of heat treatment various liquids are used for quenching purposes to impart the most desirable properties to the metals being treated.

For the resistance of wear, hardness is the most important property considered. In most cases a high hardness is desired, but this must be obtained with the minimum of distortion and without cracking. The various liquids used for quenching have different rates of cooling and so produce different degrees of hardness to the steel on quenching. Water being readily available and the simplest liquid to use is employed to produce the maximum hardness on steels that can withstand the drastic action of this quenching medium.

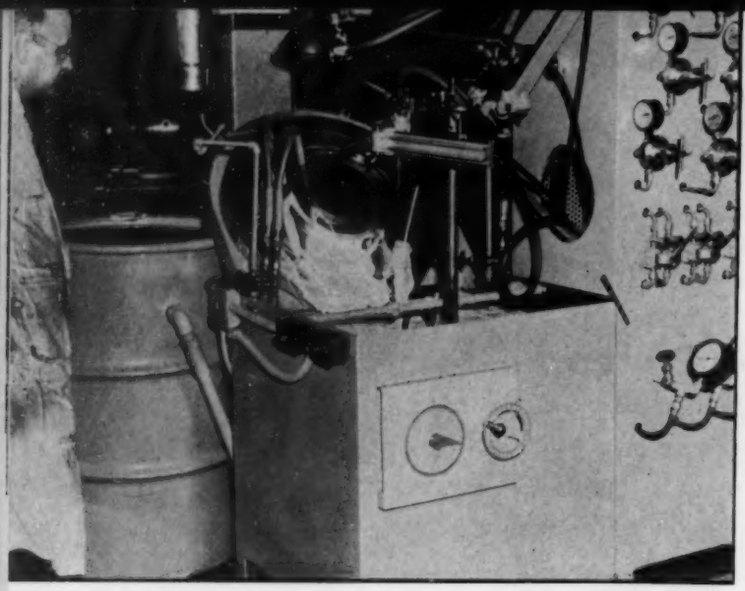
Oils are extensively used as a quenching medium particularly in the heat treatment of high carbon and alloy steels to impart a less drastic quench than water or aqueous solutions. They are used for various purposes, such as the prevention of excessive stresses, distortion, surface cracking and for the production of the proper rate of quench to obtain the desired degree of hardness. Oils are obtained from various sources and have a wide range of application. Quenching oils are divided into a number of classes according to their origin, such as fish oils, vegetable oils, animal, mineral and mineral oils compounded with vegetable and animal oils. We are not concerned herein with the source of quenching oils or their method of manufacture. Each have their uses, advantages and disadvantages. However, they do not fit into large scale flame hardening operations except those operations which are in two separate operations, heating and quenching, as in ordinary heat treating practice. Then they are used in the same manner.

In the process of flame hardening by the progressive method, that is, wherein the heating flame is moved relative to the surface of the work and followed by a liquid quenching medium, only one type of oil has been successfully used in the hardening of large surfaces. This is the water soluble or emulsion type of oil.

Teeth of an alloy steel gear being progressively flame hardened by air quenching on a gear hardening machine. Soluble oil solution is used as a coolant to prevent distortion.

Ordinary quenching oils have been and are being used in small progressive flame hardening operations where the surface of the mass being heated and the volume of flame used is small, and the relative volume of oil used as the quench is large in proportion. In such operations the quenching action of the oil is so great, due to the volume used, that the relative difference between the flash point of the oil and the temperature of the flame and the temperature of the heated surface does not have any significance. The action is the same

Presented before AISE Annual Convention, Cleveland, Ohio, October 4, 1946



Surfaces of a circular die are being flame hardened using soluble oil as a quench and coolant to prevent surface cracking and reduce distortion.

as pouring a gallon of oil on a burning match. The match will be extinguished by the oil without danger of igniting the oil.

In heavy progressive flame hardening operations on high carbon or alloy steels where water is too drastic a quench, ordinary quenching oils cannot be used because of the danger of instantaneous flashing and burning of the oil. For this reason a quenching medium that will not burn must be employed. Solutions of soluble oil and water have proven very satisfactory for this purpose as they perform two essential operational functions. First, the progressively heated surface is quenched directly behind the heating flames by a soluble oil solution spray; and secondly the solution is circulated through the heating burner adequately cooling it, without which the operation could not be prolonged for any great length of time. Adequate cooling of the apparatus prevents the preheating of the oxy-acetylene gas mixture and thus maintains the gas entering the burner at a uniform temperature, which insures a stable unvarying flame. It is this cooling function which contributes to the success of flame hardening as a practical heat treating process. The ability of a soluble oil solution to effectively cool the flame hardening apparatus permits its use as a quenching medium. However certain precaution must be observed in its use. These will be discussed later.

Soluble oil solutions in progressive flame hardening operations are employed for two distinct purposes, quenching and as a coolant. For quenching they are used in place of oil to eliminate the fire hazards and to produce the desired rate of quench. Solutions of various consistency are used depending on how fast a quenching action is desired. As no two soluble oils are alike, there is no factor governing the consistency that may be obtained with different percentage of oil and water.

Experience has shown that the many different soluble oils available will produce solutions of different strength when mixed in the same proportion. Some will be found to have a more oily nature than others. Solutions of equal strength made with different soluble oils will produce different rates of quenching. Therefore no definite quenching rate can be established for emulsions of same strength made with the various grades of soluble oils.

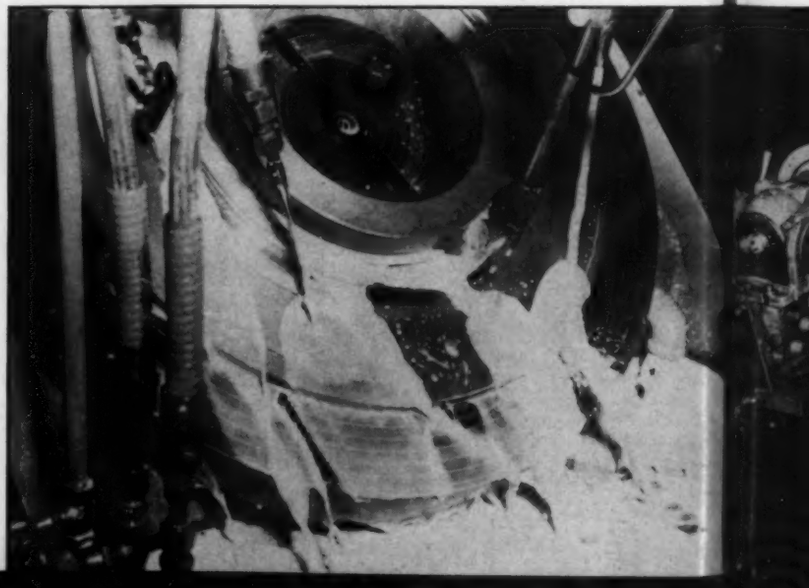
As a coolant they are employed to keep the mass of the metal being treated in a cold state to prevent excessive distortion. Due to the presence of water, the cooling properties of soluble oil solutions are exceptional.

Solutions of 20 to 1 to 5 to 1 of water and soluble oil are generally used in flame hardening operations. The proper strength of the solution is dependent on the rate of quench desired. For high carbon and critical oil hardening steels, the heavier solutions are used in order to obtain a low rate of quench. For more rapid rates of quenching the lighter solutions are used. The proper soluble oil solution to produce the desired rate of quench for the steel under treatment generally has to be determined by trial. The type of soluble oil used for the quenching medium is not critical, but the solution should be of such strength to give the desired quenching rate.

When used as a quenching medium, the soluble oil solution is pumped under positive pressure to the torch and through the burner from which it emerges as a spray onto the heated surface. When used as a coolant, the parts being treated are either immersed in the solution or the coolant is sprayed over the part to dissipate heat therefrom. There are two systems in general use for feeding the quenching solution to the torch under pressure, the pump system and the pressure vessel system. In each system an adequate quantity of solution is contained in a tank from which it is pumped to the point of operation. Cooling coils are provided to maintain the solution at a uniform temperature.

In the pump system a pump is used to supply the quench from a supply tank, under uniform pressure to the torch, through a suitable filter. The filter is essential to prevent foreign matter from clogging up the spray jets in the burner. A regulating valve is provided to control the pressure and volume of the quench used. A by-pass valve is used to relieve any excess capacity of the pump. Auxiliary quenching streams are provided when necessary for the cooling of heavy masses. The pump should be of adequate capacity to provide a

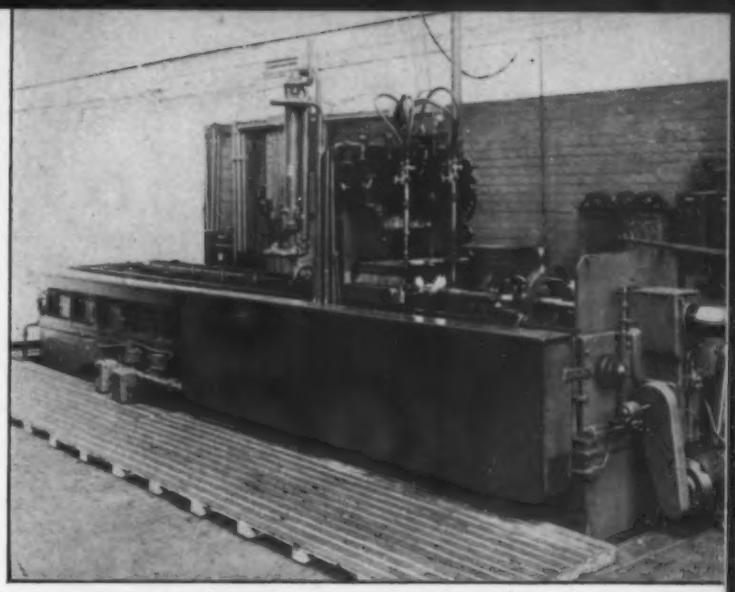
Close up of previous figure showing the quenching jets and cooling sprays.



uniform pressure to the quenching stream and a sufficient volume to the auxiliary cooling streams. Centrifugal pumps are preferable to reciprocating types, unless a suitable air chamber is included to maintain an even pressure. This system is simple to install and maintain.

In the pressure vessel system a closed pressure tank is used to store the quench solution and compressed air is used to feed it through the burner and auxiliary quenches. In conjunction with this tank a hardening tank is used, wherein are placed the parts to be hardened and into which the used quench solution drains. The pressure tank should contain sufficient volume of solution to completely quench the largest part to be hardened or to quench a large number of small parts. When it is empty, hardening must stop until the solution in the hardening tank is returned to the pressure tank. Compressed air at about 25 psi is used to force the quench through the torch depending on the size of the heating burner and auxiliary quenches. The pressure tank is generally placed under ground which makes a convenient installation, as gravity is utilized to drain the solution from the hardening tank. This system is advantageous, as all variables including pressure are under strict control. Cooling coils for maintaining a uniform temperature of the solution may be placed in either or both of the tanks. A suitable filter should be installed in the quench supply line before the solution passes through the burner. Copper or nonferrous wool have been found most suitable. Ordinary screen meshes generally clog up with the gummy deposits formed from the soluble oil after prolonged use.

During the process of progressive flame hardening, the surface under treatment is progressively heated by the heating flames and immediately quenched at a proper distance to the rear of the flames by jets of quenching medium. The quenching medium generally flows through the burner wherein it is utilized to cool the burner or it may pass through a separate quenching jet attached to the burner. In either case the quenching is performed by spraying the heated surface with multiple jets of quenching solution and thus relatively high cooling rates can be obtained. The quenching action can be regulated within limits to produce various cooling rates. This is accomplished by varying the



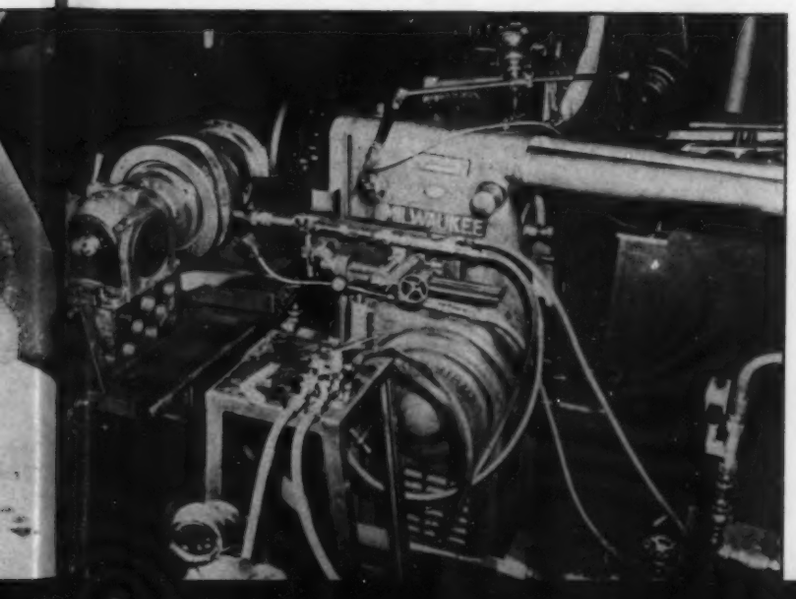
This flame hardening machine utilizes soluble oil for quenching.

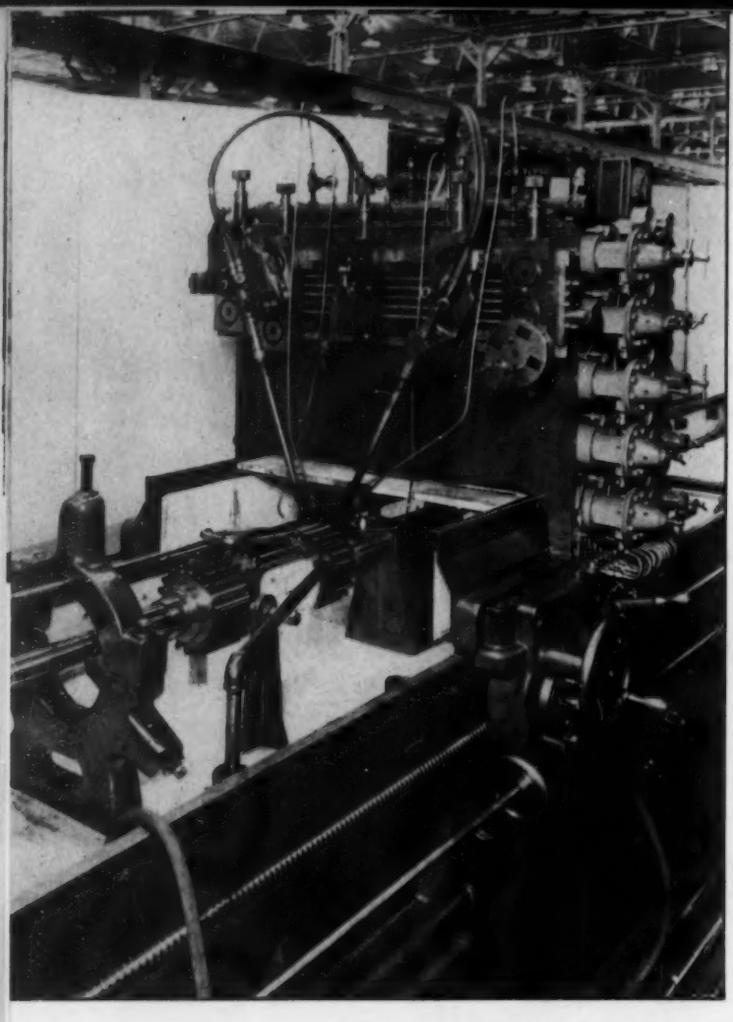
pressure and the volume of the spray. Changing the strength of the soluble oil solution used, will also produce a change in the cooling rate.

Variations in the cooling speed have a direct effect on the final hardness and the stresses that are produced in the quenched surface. If a quenching medium produces rapid cooling in the upper temperature range (about 1000 F for carbon steels) through the zone of rapid transformation, the hardness of the steel will be greater than that produced by a quench that cools slowly in this range. Likewise the final stresses in the quenched surface will be of a lower degree when it is cooled slowly through the lower temperature range (below 500 F) during the martensite formation, than if it is cooled rapidly. In this way the danger of cracking is materially decreased because the volume increase accompanying martensite formation takes place at a lower rate which tends to reduce surface stresses. Thus it may be noted that a quenching medium that produces rapid cooling in the upper temperature range, and slow cooling in the lower temperature range is more desirable from the standpoint of minimum stresses, distortion, cracking, etc., than one that produces either rapid cooling in both ranges or slow cooling in the upper range and fast cooling in the lower range.

With soluble oil solutions these desirable quenching features may be obtained. To effect the slow cooling in the lower range a strong solution should be used and by regulating the pressure and volume of the quenching spray, fast cooling through the upper range can be obtained to produce high hardness. The water in soluble oil solutions produces fast quenching in the upper range, while the large volume of oil present is effective in slowing down the cooling rate through the lower range. In addition the cooling rate through the lower range may be effectively lowered by limiting the time that the quenching medium is permitted to contact the heated surface. This may be accomplished by deflecting the course of the coolant away from the quenched surface by metal deflectors or air jets. This, in effect, is similar to time quenching procedure used in furnace heat treating. Sufficient temperature is permitted to remain in

A barrel cam being flame hardened on a milling machine. Soluble oil was used as the quenching medium.





Soluble oil also enables effective flame hardening of gear teeth.

the surface of the piece which is then cooled to room temperature at a lower rate, generally by heat condution through its mass.

In a process described as simultaneous flame hardening and tempering, soluble oil solutions are effectively

Simultaneous flame hardening and tempering is being done on the surface of a steel rail used for a railroad frog. The rail is immersed in a soluble oil solution to reduce distortion and the solution is used as the quenching medium.

used. This process is used for hardening the surfaces of high carbon steels such as railroad frog rails and street car rails, wherein maximum hardness is avoided and a medium degree of hardness on the order of 350 to 450 Brinell is desired. The rail to be treated is immersed in a soluble oil solution, leaving only the head exposed. The rail head surface is progressively flame hardened by heating with a proper size burner and quenching with the same soluble oil solution in which the rail is immersed. At a suitable distance to the rear of the quenching jets and simultaneously following the first burner, a second burner is used to temper the hardened surface. Between the two burners an air jet is interposed. This air jet blows the quenching medium from the rail surface thus allowing the quench to be effective for a definite time period. Residual heat is thereby left in the surface of the rail. The tempering flame moving simultaneously along raises the surface temperature to the proper degree to produce the desired hardness, after which the rail is either allowed to cool to room temperature by conduction of heat through the mass of the rail or auxiliary soluble oil cooling streams are used for this purpose. A soluble oil solution of proper strength and volume is used to obtain a lower cooling rate than water. A surface hardness below maximum is obtained, and the quenched surface is only partially cooled so it can be effectively tempered by the second series of flames to the desired temperature and hardness.

In progressive flame hardening of deep hardening steels having low critical cooling rates, still air is used as a quenching medium, and a soluble oil solution sprays are used to cool the mass of the part being treated. The sprays are directed away from the areas being hardened, and are only permitted to come in direct contact with these areas after complete transformation has taken place. The sprays effectively cool the mass and reduce distortion to a minimum. In some instances, instead of sprays, the mass is immersed in the soluble oil solution leaving the surface being flame hardened exposed to quenching by the surrounding air and by heat conduction through the mass.

In most progressive flame hardening operations, spray quenching streams are used and therefore evaporation of soluble oil solutions is negligible as the sprays produce rapid cooling and the area quenched is generally small in comparison to the volume of the spray used. Pressure spray quenching produces uniform hardness and freedom from soft spots is assured. If soluble oil solutions are kept at a uniform temperature by suitable cooling coils, decomposition from prolonged usage will be greatly reduced. However there is no conclusive evidence that this is true of all grades of oils. As a solution is used over and over again, such a breakdown is highly undesirable for the maintenance of uniform results. A soluble oil solution should also produce similar quenching action regardless of its age. After a solution has been in use for some time, it may be necessary to check its strength. This can easily be done by adding a little dilute (10 per cent) hydrochloric acid to a known quantity of the oil solution in a graduated glass tube. This will break down the emulsion, so the oil will separate visibly, and a simple proportion will enable an operator to determine the concentration of oil in the

emulsion. Oil or water is then added to bring the solution to its original strength.

The foregoing has shown the field of usefulness of soluble oils in flame hardening operations. However because soluble oils are processed by various methods, no two oils are alike, hence solutions of same strength made with one oil will not produce the same cooling results as obtained with another oil. Therefore for flame hardening operations in any plant, it is necessary to standardize on one type or otherwise it would be necessary to change procedures when oils are changed.

In using soluble oil solutions, caution should be exercised to prevent any oil from entering the flame hardening apparatus particularly the oxygen pressure regulators or any piece of apparatus through which oxygen must pass. Oxygen under pressure coming in contact with oil in confined spaces presents an explosive hazard.

There is a definite field for the improvement of soluble oils for quenching purposes in flame hardening operations.

Some of the characteristics required for satisfactory soluble oil solutions may be listed as follows:

1. Ability to quench steel rapidly through the critical zone, and at a slower rate in the lower temperature range of martensite transformation.
2. Must retain its rate of cooling indefinitely.
3. Should not be affected by a moderate temperature rise.
4. Should not decompose with continued use.

DISCUSSION

PRESENTED BY

H. W. JOHNSTON, Staff Lubrication Engineer, The Standard Oil Company, Cleveland, Ohio
STEPHEN SMITH, Air Reduction Sales Company, Cleveland, Ohio

H. W. Johnston: I should like to ask the author if he has measured the difference in the thermal conductivity between water and water soluble emulsions.

Stephen Smith: We have not conducted any research along that line.

H. W. Johnston: However, you recognize there is a difference by using emulsions in certain cases to prevent excessive surface cracking during quenching?

Stephen Smith: We recognize that fact but we have not done any work along that line. The presentation of this paper was to encourage some work along that line by producers of soluble oils.

PLAN EXPLORATION OF UTAH COAL LANDS

▲ NEGOTIATIONS for a $250,000 exploratory project on public lands in Carbon County, Utah, designed to increase the available supply of coking coal for metallurgical use in Western States, are being conducted by the Federal Government with two western steel companies, Secretary of the Interior J. A. Krug announced today.

Funds for the proposed project would be provided by the Geneva Steel Company, a subsidiary of the United States Steel Corporation which is operating the former government-owned steel plant at Geneva, Utah, and the Kaiser Company, Inc., operating a steel plant at Fontana, California.

The program, similar to other cooperative agreements between Interior Department agencies and private industries, would seek to determine the amount, locations, and quality of coking coals available in an area north and west of the town of Sunnyside, in Carbon County. Coking coal is now being mined south of Sunnyside.

The exploration, Secretary Krug stated, will be supervised by two department agencies, the Bureau of Mines and the Geological Survey. Upon consummation of the proposed agreement with the companies these agencies would carry out all the necessary geological work, select drilling sites, contract for drilling operations, and conduct analyses and tests of the coal in laboratories and plants to determine its carbonizing properties.

Drilling sites already have been selected by the department in the Sunnyside coal field so that work may be begun immediately. Contracts for the drilling work will be let to private contractors on a competitive basis after the agreement for the project is signed.

Previous Bureau of Mines carbonizing tests have determined that coal from the Sunnyside field, south of the town of Sunnyside, is suitable for the production of coke, one of the essential ingredients in steel-making. However, the need for more metallurgical coal to supply western industry has been increasingly urgent, and additional sources of coking coal must be found in order to assure the continuation of the industry and its expansion.

Both the Geneva Steel Company and the Kaiser Company hold coal leases on public domain in the Sunnyside field and now obtain metallurgical coal under these leases. The new agreement will contain an amendment to the Code of Federal Regulations, Public Lands, providing "that any person or organization furnishing money for exploration and prospecting in order to determine the existence of metallurgical coal may receive without competitive bidding a lease of such lands, not to exceed the acreage allowable by law, the coal to be extracted and processed primarily for consumption in connection with the production of ferrous materials by the lessee."

Each of the companies will contribute $125,000 and unexpended funds will be returned to them after the completion of the project, which is expected to take about six months. The government will make progress reports or interim reports on the work, and at the conclusion of the investigation will prepare a final public report on results.

Modern Electrical Control
FOR WIRE MILL MACHINERY

. . . . improvements in wire drawing processes and dies have forced the electrical manufacturers to constantly improve their electrical control systems, in order to properly and accurately regulate the drawing operation . . . .

By O. M. BUNDY
Assistant Chief Engineer
Clark Controller Company
Cleveland, Ohio

O. M. BUNDY

▲ THE first consideration in writing this paper was to discuss primarily the control equipment for wire mill machinery. However, the control can be best discussed not in terms of contactors and relays, but by the performance that the electrical driving system gives to the machine. This subject will be considered particularly with respect to the complete electrical driving system because only such a discussion can present an overall performance picture. This subject is quite broad because of the wide scope of the wire industry. The problems of the wire drawing industry will be presented as they have been presented to the electrical manufacturer with the methods used to solve them successfully.

No attempt will be made to include any more of the history of wire drawing or of the electrical equipment for such machines than is necessary to bring out certain points, because practically everyone in the wire drawing field either has first hand knowledge of what has been used in the past, or has had the advantage of the excellent papers which have been previously presented to the Association of Iron and Steel Engineers.

Naturally many of the details of the various types of electrical systems must be omitted. However, details are important because the special consideration of details quite often makes the difference between an economical and efficient operating job and one which can be classed as just another installation.

It has been proved, based on experience in this industry, that the electrical manufacturer can be of greatest service by continual contact with the men who draw the wire and the men who make the machinery to draw the wire.

There is no question but what improvements in the industry are made every year which produce better wire at a lower cost. These improvements have been made in all fields, the drawing technique itself, the lubricant, the dies, the makers of the machinery, and the quality of the rods.

The improvements in each of the fields, both singly and together, have continually presented the electrical industry with increasingly difficult problems. It has been necessary not only to keep up but also to anticipate what will be required in each succeeding year.

In the field of wire drawing in general, consideration must be given all products, which vary from rod down to the very finest wires, and whose physical characteristics vary from common products and nail stock to spring wire of all kinds, rope, music, and alloy wire. These classifications apply to the steel industry; however, the same range of sizes is used in both the copper and aluminum fields.

While some of the types of machines are used mostly in the steel industry at present, there are also applications to a lesser extent for these types in drawing copper and aluminum. There are also some types of machines whose principles are used in all fields. All of these major types are included in this discussion.

Since the advent of the tungsten carbide die in the late twenties, the solution of many of the problems encountered at that time has been made much easier. As is usually the case, as soon as a better product is made available to the wire users, they want still a better one and of course they want it at a lower cost. Consequently the wire industry continually finds itself confronted with closer specifications on gage tolerance, higher requirements of tensile strength, better finished surfaces, and in many cases greater ductility. Many specifications which were impossible 5 years ago are now being met, and it is safely assumed that requirements which are now impossible, or only possible at very high cost, will be met in the next several years at lower costs.

The result of all these factors has been that the electrical manufacturers have had continually to improve

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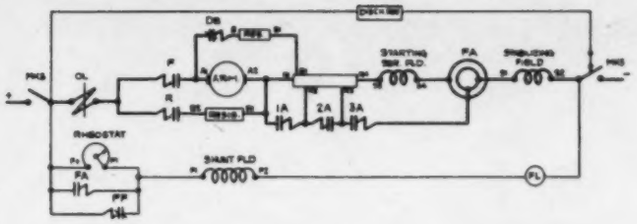


Figure 1 — The electrical control system shown gives slow speed for threading plus smooth acceleration for starting.

the previous electrical systems and in some cases to change electrical systems as it became more and more necessary to control the process precisely.

Emphasis is laid on the following statement because it will be referred to continually throughout this discussion. In the drawing of any particular wire, some economic speed can be found with certain die and lubricant combinations which will enable that wire to be drawn as fast as possible, and still have the proper physical characteristics such as, tensile, gage tolerance, finish, ductility, etc. It is naturally to the advantage of a wire mill to produce that wire at that economic speed if possible, with the least amount of labor cost involved, balanced of course against the investment in equipment.

For the purpose of this paper, wire drawing equipment in general can best be discussed under the following classifications:

1. Single motor — 1 or 2 die machines.
2. Single motor — slip machines.
3. Single motor — non-slip machines.
4. Multiple motor — non-slip machines.

Each of these classifications will be discussed with respect to the electrical systems used with the various types of machines. Since the electrical system cannot always be dictated by the machine alone, quite often for economic reasons, it will be best to classify and describe the various systems which are used on these machines in modern practice.

The principal systems now in use on drives of this kind are as follows:

1. Single drive by a-c squirrel cage or wound rotor motor.
2. Single drive by d-c adjustable speed motor, powered from a constant potential system.
3. Single drive by d-c adjustable speed motor, powered by a variable voltage system.
4. Multiple drive by d-c adjustable speed motors, powered from a constant potential system.
5. Multiple drive by d-c adjustable speed motors, powered from a variable voltage system.

Other systems have been used, but since the above cover the vast majority of drives being installed and used at the present time, the discussion will be limited to these.

SINGLE DRIVE BY A-C MOTOR

The single motor drive by either a-c squirrel cage or wound rotor motor naturally is a constant speed, constant horsepower drive. Some of the machines on which these drives are used may have two or three gear changes, however, the operator is limited to certain definite speeds and can only hope to approximate the economic speed for any particular product. A-c motors of the squirrel cage type are usually limited to rather small machines, and motors of the wound rotor type are used on larger machines where it is necessary to get a smooth and even acceleration.

A variation on the squirrel cage drive has been to introduce an eddy current clutch between the motor and machine. Either this system or a wound rotor motor can be used to obtain some speed adjustment under heavy load conditions. The speed adjustment in either case is usually limited and accompanied by a considerable increased cost of power.

The a-c single motor drive does not lend itself to quick stopping when required, since the only practical means to stop either a squirrel cage or wound rotor motor is by a mechanical brake, a method of d-c braking, or plugging.

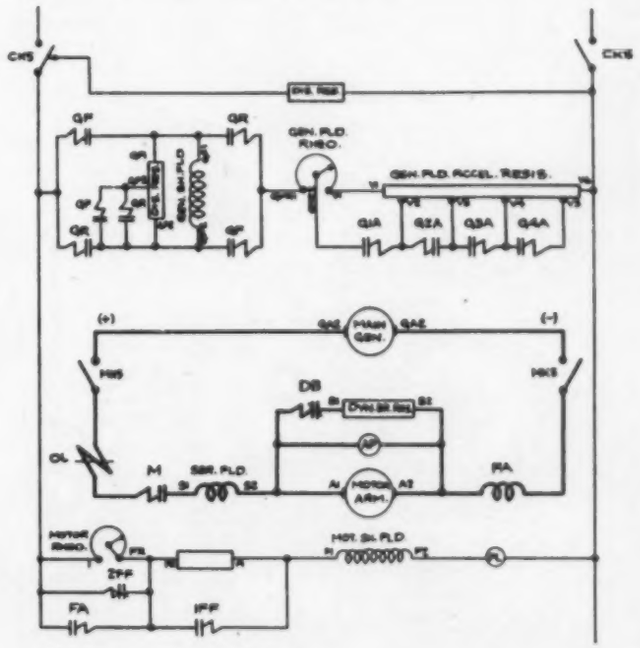
SINGLE DRIVE — D-C MOTOR

The single drive by a d-c adjustable speed motor from constant potential, of course can be used where there is an adequate supply of direct current. This drive is built practically to cover a 4 to 1 speed range or less and is essentially a constant horsepower drive.

Within the speed range of the motor, the economic speed for any particular product can be found, and the use of such a motor also lends itself quite readily to slow jogging and threading speeds and quick stopping by dynamic braking.

The single drive by a d-c adjustable speed motor from a variable voltage system is a constant horsepower drive when the generator voltage is maximum. The horsepower drops as the generator voltage is reduced but since the same torques can be maintained, within the heat dissipating capacity of the motor, this system

Figure 2 — This electric drive is powered from a variable voltage system, and eliminates the starter and many of the heavy current contactors.



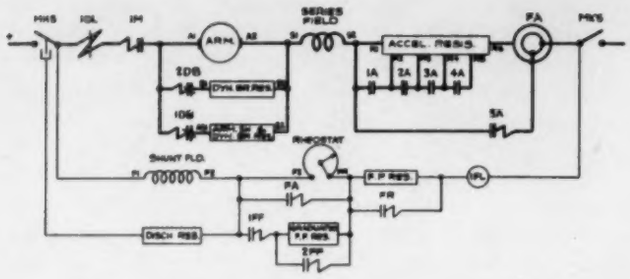


Figure 3 — No reverse point is necessary in the control scheme illustrated, and stopping is obtained by dynamic braking.

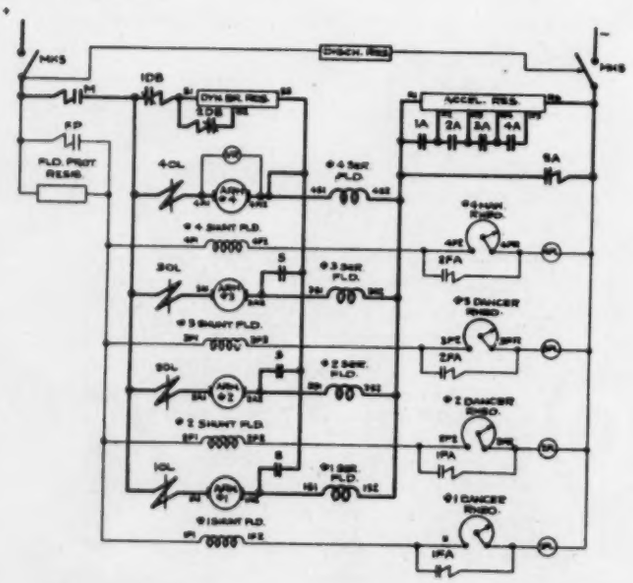
offers all the advantages of the d-c adjustable speed motor plus other advantages under certain conditions which will be discussed when the various types of blocks are considered.

MULTIPLE DRIVE — D-C MOTORS

The multiple drive by d-c adjustable speed motors, powered from a constant potential system, is widely used and each drive is of a constant horsepower type. In a system of this kind, which of course is used only on a continuous type of machine, the fields of the various motors are controlled by dancer roll rheostats between the various capstans. Thus it can be said that the motors operate individually to take care of synchronizing the various capstans, but act collectively as far as acceleration, deceleration, and quick stopping are concerned. When an ample d-c power system is available, this drive gives excellent operating results. The main limitation on this type of drive is that the speed range of the machine is limited to the operating speed range of the motors less some range for stability and field forcing, and also less the variation in drafting which is commonly encountered.

The multiple motor drive by d-c adjustable speed motors powered from the variable voltage system is similar to the previously mentioned constant potential system. However, there are several important operating advantages which will be discussed, particularly with respect to a multiple motor non-slip machine.

Figure 4 — Control scheme for multiple motor, non-slip machine. Motors are d-c, adjustable speed, constant potential.



Please notice that two of the systems mentioned use variable voltage control. It is beyond the scope of this paper to attempt to evaluate this system of control except with respect to wire drawing equipment. However, it should be remembered that this system operates from alternating current and considerable data has been published on this subject lately in the *Iron and Steel Engineer*.

One further problem which always must be kept in mind is the diversity required of wire drawing equipment with respect to the particular mill in which it is being installed.

In a large wire mill, it is the usual practice to install a certain number of machines for drawing common products. Another group of machines will be installed to handle alloy or high carbon such as spring, music or rope wires. In many of the larger mills there may be five or six groups of machines, each of which will give the correct range of economic speeds for the production of certain types of wire. There is no question but what this is sound practice, but of course any such installation must be based on a fairly even flow of all kinds of business to get the most out of the investment in the equipment.

It is well known that there is no such thing as normal business. In fact it is the abnormal conditions rather than the normal which usually make any business not only interesting but also give it many of its troubles.

This problem has been presented to the electrical manufacturer time and again because some particular mill has found that it had to run an enormous quantity of a certain kind of wire in a short time, and found that it was impossible to run this quantity with the machines they had available for that specific product. Therefore, the only alternative to get them out of the emergency, was to use other machines which had been designed for other products. In other words, in everybody's business, is not the emergency the usual condition?

The answer to problems like this has been to make every machine as flexible as possible so that the widest practical diversity can be obtained on any particular machine. Of course this always has to be balanced against the cost of the equipment. However, it can be said positively that many mills have checked into the possibility of, for instance, buying one machine with one electrical system against another with a wider diversity factor and have found that the extra diversity has cost them very little more, and in some cases they have been very happy to find it has actually cost them less.

This diversity factor will be mentioned in the discussion of the various types of electrical systems for blocks, because it must be considered in order to give any mill a true picture of what is the best equipment to buy.

With the various types of electrical systems in mind, their application to the specific classes of machines previously mentioned will be discussed.

SINGLE MOTOR—1 OR 2 DIE MACHINE

The old system of single die drawing of wire employed a number of capstans with clutch connections to a drive shaft. This type of machine has been gradually superseded by the single motor drive for each capstan. In practically all installations in the steel industry, a direct current adjustable speed motor is used. The few cases where an a-c motor has been applied to this type of block can be considered exceptions.

Most operators are familiar with this block which is used primarily for reducing rods, either in preparation to putting them on a continuous block for finishing or where only a relatively small reduction is required. They are mentioned as a one or two die block because many of these machines are constructed with a double deck capstan so that wire can be drawn through two dies by the same capstan. The dies must be rather close to the ratio of the size of the blocks with a slight allowance for slip on the first draft block. Since the rod has usually been coated just before it goes to this machine, the small amount of slippage found when double decking is not objectionable.

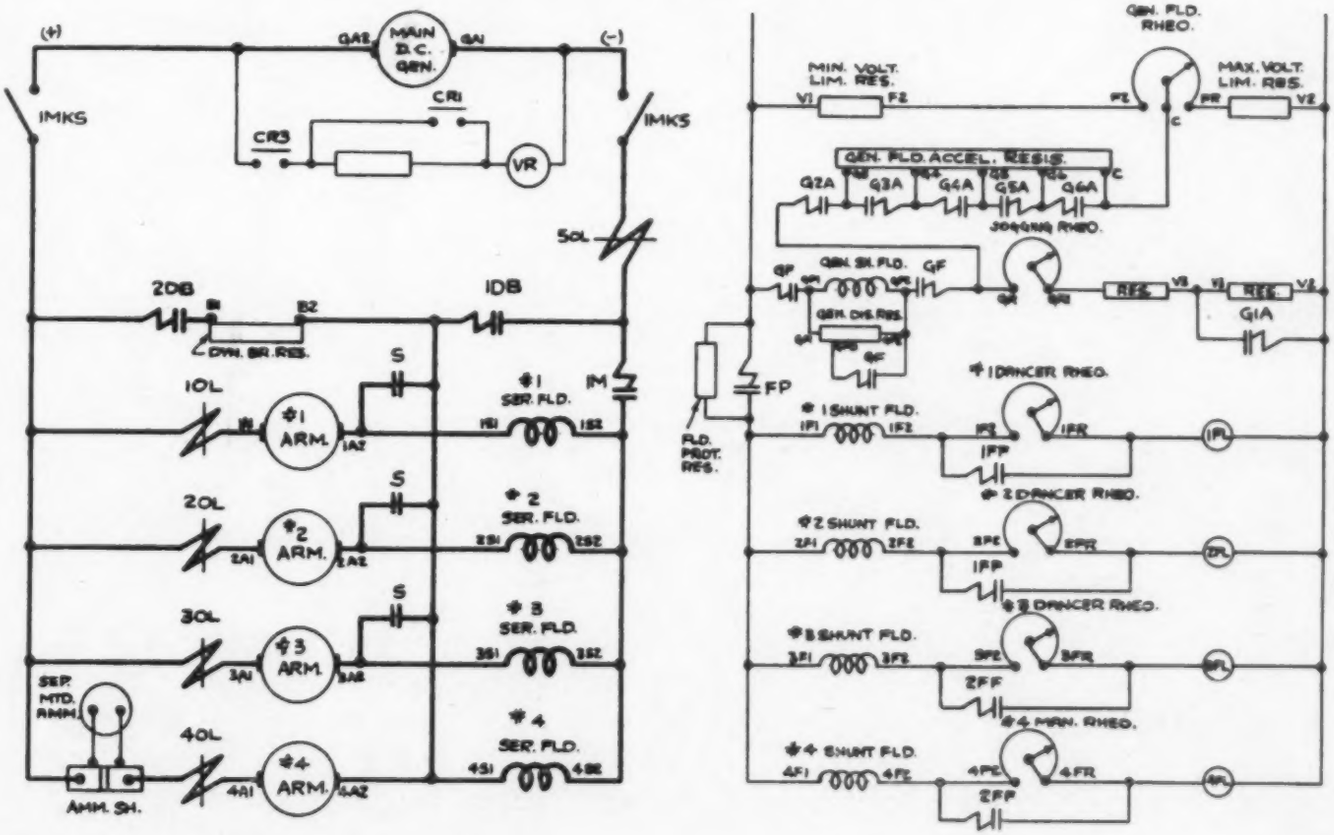
The most common electrical system used for this is the single drive d-c adjustable speed motor powered from a constant potential system. The motor itself is a special design having shunt and stabilizing fields, and also a special series field to obtain maximum torques for starting. The electrical control used with it is shown in Figure 1. This can best be described by saying that it gives a very slow speed for threading, by means of a double armature shunt, and also that the system gives the proper speed torque characteristics for starting the wire through the die without breaking off the point. The acceleration is accomplished by the two armature shunt points, and either three or four extra accelerating contactors which operate in time sequence to give a smooth voltage change to the motor armature to insure an even start without jerks. After the full field motor speed is reached, the motor is further accelerated by means of a field accelerating relay. Stopping is obtained by applying dynamic braking with full field on the motor. A slow speed jog reverse is obtained without extra equipment by closing one of the armature shunt contactors.

The majority of these blocks are equipped with this kind of equipment and are doing an excellent job since the gearing can usually be picked to cover the economic speeds for the wire sizes to be drawn and since d-c power of sufficient capacity is usually available.

A problem often arises where several of these machines are to be installed in a location where direct current power is not available. A single d-c generator to provide constant potential power for the group is usually used. This arrangement has given good results and is economically sound practice.

Another electrical system for this type of block has been in successful operation for several years and gives good results. It is a single drive by a d-c adjustable speed motor powered from a variable voltage system. This was first installed in a plant where only one block of this kind was required and where d-c power was not

Figure 5 — The variable voltage system for multiple motor, non-slip machines gives more stable jogging conditions than the constant potential system.



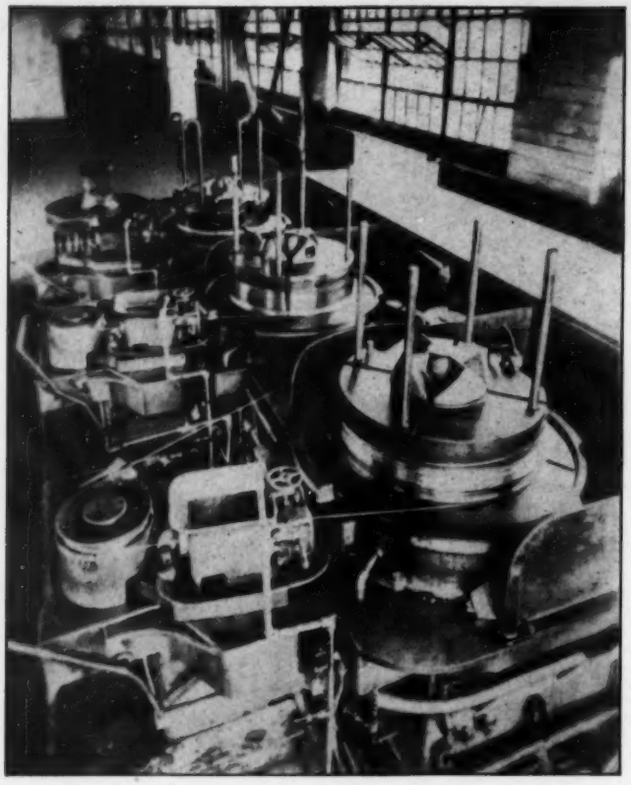


Figure 6 — Three single drive blocks are arranged for single or tandem operation.

available. The electrical equipment furnished included a motor generator set and starter for operating from the a-c power supply. The control system used is shown in Figure 2. Several comments are worthy of mention on this system. The number of heavy current carrying contactors was considerably reduced and the starting resistor was eliminated. The motor used was of special design in that the same results as were obtained from the previous type of system were now obtained by use of a special shunt and series field.

It was found that operating characteristics of this system would duplicate those of the system previously mentioned. It was also found that the diversity factor was increased by allowing a wider range of speed on the block than would be obtained with the same machine operating from a constant potential system.

To sum up the conclusions for the electrical system for this type of block, if the economic speeds for the wires to be drawn fall within the speed range which can be obtained by the motor field, then the constant potential system mentioned should be used. If a wider diversity is required than can be obtained within the speed range of the motor or if a single machine is to be installed where d-c is not available, then the variable voltage system should be used.

Another problem that has been presented along this same line is that of a user who has two, three, or perhaps as many as five single drive blocks which he desires to operate in tandem under certain conditions. This has been accomplished by using a control for each motor, similar to that shown in Figure 1, and by adding the necessary control equipment to tie the controllers together. On all motors but the last one, the rheostat shown is replaced by a dancer roll rheostat operated by an arm between the capstans. The method used to tie these controllers together is rather involved, and an explanation would be lengthy. However, installations are in operation where as many as five motors can be operated individually, all in tandem or in groups.

SINGLE MOTOR SLIP MACHINES

This classification includes both cone and tandem machines. In those of the cone type the wire is drawn between two capstans of progressively larger diameters, each one being built in the shape of a cone pulley. This machine is usually enclosed and operates with a liquid lubricant. Since the successive ratios for each successive draft are fixed by the size of the cones, the dies must be very carefully selected. Of course it is impossible to hold the drafting exactly right and therefore some slippage occurs.

In the steel industry such a machine is usually used only for reducing wires of No. 12 gage and smaller, down to fine wire. For these small machines an a-c constant speed drive has been supplied on some applications; however, the majority of machines use a d-c adjustable speed motor from a constant potential system. Since the horsepowers are rather low a large amount of power is not involved. The d-c adjustable speed motor on a machine of this kind allows the various sizes of wire to be run at their most economic speeds, and the control equipment is similar to that of Figure 1 with several simplifications.

Similar machines are used in the copper industry where the starting size is ½ in. copper. On machines of this type, several hundred horsepower is involved and the majority of these machines which are used at the present time are powered by wound rotor motors having sufficient accelerating contactors to obtain a smooth acceleration, or squirrel cage motors with eddy current clutches. These machines often have two or three speed changes built into the machine so that the operator can approach his economic drawing speed. However, this is essentially a constant speed system, as the operator is limited to the speed of the motor plus whatever gear changes are available. Where a large quantity of wire of the same size and characteristics is being continually handled, the use of this system is satisfactory and is economically sound.

Recently an installation has been put into service where an adjustable speed d-c motor powered from a variable voltage system has been used to drive such a machine. From the results of this machine to date, it appears that this system will offer certain advantages which may more than justify the additional cost of the equipment. The added advantages of this system in continuous running are that it offers quite a diversity, and that the economic speed for any particular wire can be used. Another advantage is that the jogging speeds and torques can be quite accurately controlled since these will not vary as much with load as on a-c systems. Still another advantage is that the rate of acceleration can be controlled practically independently of the load. This last factor is not too important, if the block is run by itself and if the wire is bundled on

the capstan driven by the same motor. However, it is quite common practice to use a separate spooler tied in with a machine of this type, and the variable voltage system of control together with a similar system on the spooler motor allows much more precise control of acceleration, deceleration, and emergency stopping than is possible with other systems.

To sum up the systems used on the single motor slip machine, the d-c adjustable speed motor, from a constant potential source, is usually best suited for the size of wire drawn in the steel industry. Slip ring motors are most commonly used in the copper industry where large quantities of the same wire must be continually handled and this is economically sound under certain conditions. However, if a user is going to use such a machine with a spooler, or if more diversity is needed to get certain economic speeds, then he should weigh the added diversity and performance available with the d-c motor and variable voltage systems against the extra cost involved before making a decision either way. In other words, more can be done with this system, and if the user can economically use the extra performance features available, then the variable voltage system described will give it to him.

SINGLE MOTOR NON-SLIP MACHINE

This type of machine consists of several capstans all geared solidly to one motor. The dies for such a machine are usually selected to accumulate wire on the capstans. If the drafting is exactly right, then no wire is taken off or added to the various capstans during the operation of the machine. However should the drafting vary from the gear ratios, then wire will be added or taken off the various capstans during the wire drawing operation.

A constant speed squirrel cage motor in the smaller sizes, and a slip-ring motor in the larger sizes can be used if the user can economically operate his machine at one speed only. However, the majority of these machines are powered by a direct current adjustable speed motor powered from a constant potential source. The control method is very similar to Figure 1, but since a reverse point is not necessary, the control as shown in Figure 3 is usually used.

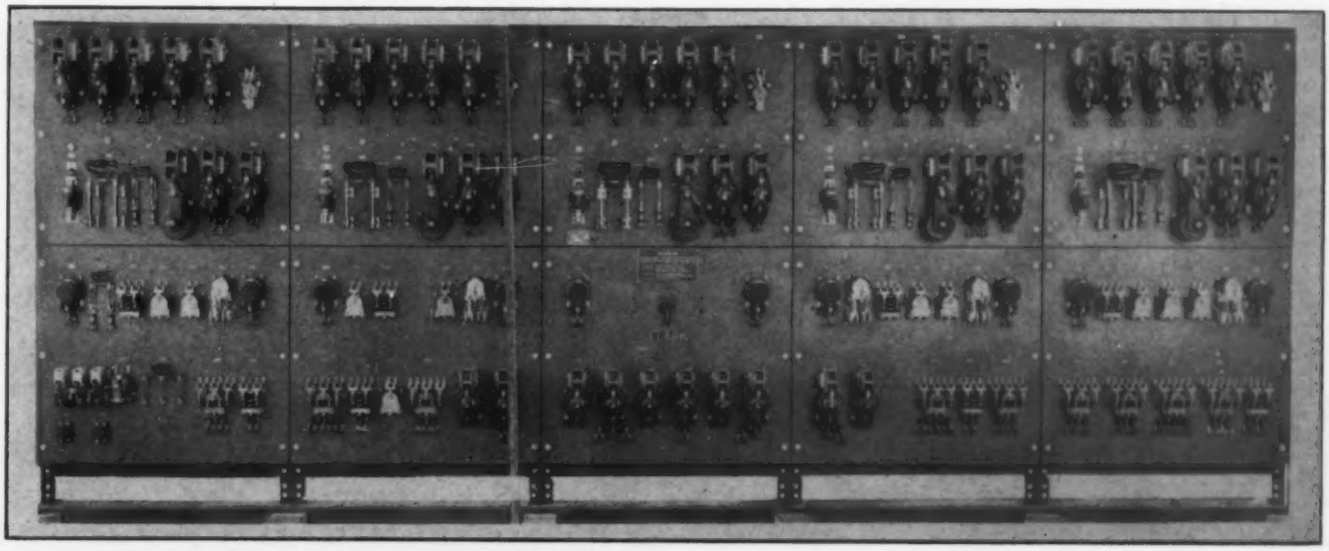
Here again the control accomplishes practically the same functions as those for single motor 1 or 2 die machines, as shown in Figure 1. The two armature shunt points give stable speed for threading, and these points and the accelerating contactors are used to give smooth acceleration. Stopping is obtained by dynamic braking.

Practically the same factors mentioned concerning the single motor one or two die machines, as far as diversity is concerned, will apply to this type of a block also. Also the same considerations mentioned previously regarding an adjustable d-c motor powered by a variable voltage system would apply equally to this type of machine if d-c power is not available or if speed ranges are desired beyond the range of the d-c motor. The conclusions regarding electrical systems on this type of block can be said to be practically the same as for the first type of block mentioned.

MULTIPLE MOTOR NON-SLIP MACHINE

This machine is distinguished from the previous types mentioned by the fact that every attempt has been made to keep slippage to an absolute minimum and not require a large storage of wire on each capstan. Each of the capstans is individually driven by a d-c adjustable speed motor having a speed range by field of from 2 to 1, to 4 to 1, depending on the requirements. Slip is avoided by having each motor in the train, with the exception of the last one, controlled by a dancer roll rheostat which is operated by a tension arm between the capstans. It would of course be possible to operate such a block as this with only enough tension on the arm to make sure that the loop of wire controlling that arm is pulled sufficiently tight to give a true positioning

Figure 7 — This control panel for five single drive machines has provisions for single, group, or tandem operation.



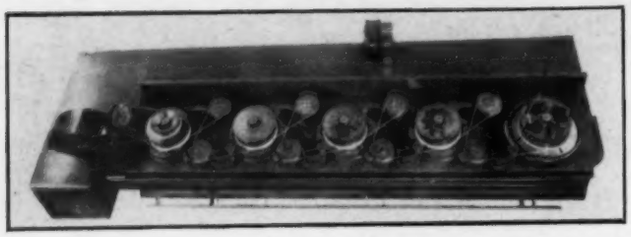


Figure 8 — Top view of a multiple motor non-slip machine.

of the rheostat. However, following the practice used on many cold reducing mills, tension by means of spring loading is usually put on these arms to exert a back pull of a considerable amount on the wire as it enters the next die.

The problems presented in controlling a drive of this kind include the individual problem of synchronizing and stabilizing each capstan and the collective problem of accelerating, decelerating and fast stopping.

This problem is further involved by two additional factors. The first capstan is quite often double-decked so that either one or two dies may be used with it, and also the last spindle may be designed to use two or possibly three different sizes of finishing blocks to supply the proper diameter bundles for the rest of the mill.

The motors used on these machines have special characteristics to provide the proper stability and speed range. A large amount of development has provided a design of motor within the last year or so which is superior to those which were available previously for this service. The motors driving the capstans are commonly of the same size, although one larger size may be used on the first motor when a double die is used.

The electrical system most commonly used in the past, and still very widely used, is the multiple drive by d-c adjustable speed motors powered from a constant potential system.

Representative control equipment for this application is represented in Figure 4. This particular diagram shows only four motors, however, machines of this type have been supplied with as many as six and seven

Figure 9 — A group of multiple motor non-slip machines.

motors and satisfactory operating results have been obtained.

Expanding on previous comments with regard to this multiple d-c drive, the motor itself with its attendant dancer roll rheostat must do the job of synchronizing and stabilizing itself. The rest of the system must handle the motors collectively, so that it is within the range of the motor and its rheostat to stay stable while the machine is being accelerated, operated, and stopped.

As shown in the diagram, a relatively large number of accelerating contactors are used during the starting period. Stopping is obtained by two steps of dynamic braking with full field being applied at the proper time.

The diagram shown illustrates the fundamentals involved. In actual usage this system may be changed to accommodate some of the special conditions mentioned regarding this type of machine.

Repeating the comments made earlier on this system, particularly with respect to this type of machine, namely that when an ample d-c power system is available, this drive gives excellent results. The main limitation on this drive is that the speed range of the machine is limited to the operating speed range of the motors, less some range for stability and field forcing, and less the variation in drafting which is commonly encountered in various sets of dies. If more than one size of finishing capstan is to be used, the difference in sizes must also be compensated for by the field range on the finishing motor.

The electrical system using a multiple motor drive powered from a variable voltage system was first put into operation between six and seven years ago, and from that time on, this electrical system has been increasingly used. In the application of this system to a drive of this kind, where a four to one field range motor has been previously used, the speed range by motor field was reduced only to that required for the different sizes of finish blocks, the drafting range likely to be encountered, and that needed for stability and field forcing. By raising the base speed of the motors, or by over-voltage on the motors, provided they were designed for this, it was found that in practically all cases the same motors could be run with much more stability at high speed due to operating at stronger field conditions. These changes also increased the horsepower available on the blocks at the high speed and allowed the user to go to a higher economic speed where the drawing conditions would allow it.

A machine of this kind cannot be considered as having a constant torque load since it must of necessity have certain horsepower available at lower speeds. Perhaps the best way to analyze the condition is to think of the idea of simply using over-voltage on the motors. Thus, without any other changes the same horsepower is available at the low speed as obtained before when running these motors from a constant potential system, but there is more horsepower available at the high speed because the amount of over-voltage raises the operating base speed of the motors by the same amount.

The loss of speed range by field control of course was made up by varying the voltage and the fact that the voltage can be set at any reasonable value desired gives the machine with this system quite a wide diversity factor.

One of the most important operating improvements which has been found using the variable voltage system is the better acceleration and deceleration obtainable with a comparable amount of equipment. This is particularly important on high speed machines. This has been obtained by careful design of both the control circuit and the generator field.

The variable voltage system also allows a steady jogging voltage to be used and it does give more stable jogging conditions than can be obtained with the resistor arrangement shown in Figure 4.

The control system used for this drive is shown in Figure 5. The main point of interest with this particular system is the fact that instead of dynamic braking from top speed, a regenerative braking system is used down to a low speed where dynamic braking is used to make the final stop.

With such a system as this, a special design of generator is preferable so that the maximum regenerative current can be obtained during stopping and also so that the generator field and the control system can supply a smoothly rising voltage for acceleration and the reverse for regenerative braking.

Here again, this circuit is modified quite extensively at times to take care of particular problems on certain machines. In general this basic system is used and has given excellent results.

In the economic picture with a drive of this type, the motor generator set with its accompanying starter must be considered in the same light as any other a-c to d-c conversion unit. The comments previously made about the same relationship on single motor one and two die machines apply equally here. The direct current control shows greater simplicity and a saving in that the armature resistor and accelerating contactors are eliminated.

In summing up the conclusions for this particular type of machine, if the user has an ample supply of d-c power, and if the drive powered by a constant potential system will give him the diversity factor and performance which he feels is ample, then this system should be used.

If there is a possibility of his being able to use higher economic speeds later which will require better performance and perhaps more horsepower, or if he wants a wider diversity factor, then the variable voltage system should be used.

If the user should find that he must install additional d-c capacity for new machines, then he should carefully investigate not only the factors as mentioned above, but the cost of the extra d-c installations, and weigh those against the cost of the variable voltage installation to see just which works out to the best advantage. The conditions are not the same in any two plants and therefore an exact recommendation cannot be made. However after consideration of these points, more and more installations of variable voltage are being made. It can be said definitely that if a-c only is available, the economic picture usually works out best in favor of the variable voltage system for each individual block instead of installing a complete new d-c constant potential system.

In concluding this discussion a few predictions as to what the wire drawing problems are going to be in the future might be ventured. There is no question but what the economic speed for various types of wires is going to be raised gradually by a combination of the improvements which are being made in metal, drawing practice, lubricants, and machinery. The industry will be able to deliver better products at lower cost. Many of the alloy wires will be handled more efficiently and their economic drawing speeds raised.

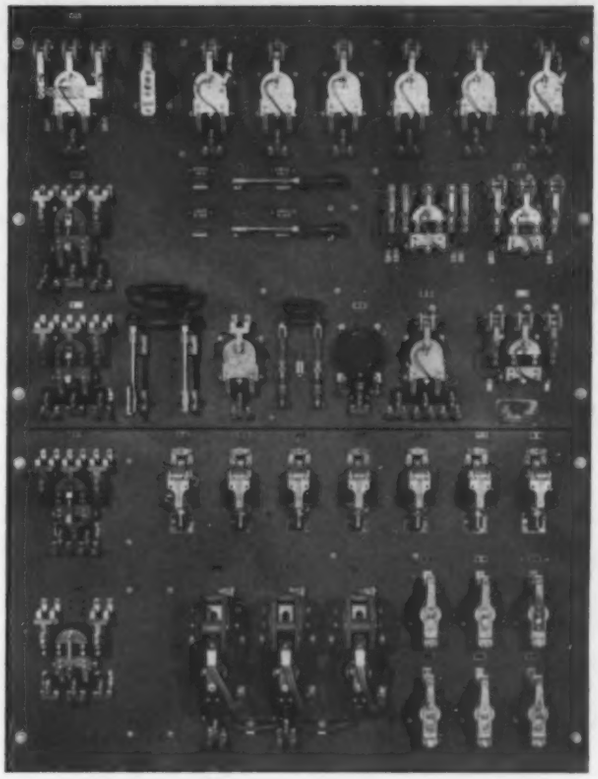


Figure 10 — This d-c control panel controls a six motor non-slip machine powered from a variable voltage system.

All of these factors are going to require improvements in all of the electrical systems mentioned. Higher economic speeds are going to require more precise control of every function of the machines, and the problems will be to achieve this control without excessive amounts of electrical equipment being required. The last few years have definitely shown that the variable voltage system on several types of machines, has its place, and that its place will be larger as economic speeds are raised. Although not specifically mentioned, an electronic system of a-c to d-c conversion is practical, particularly on the smaller machines involved.

The electrical industry fully realizes the problems with which it will be presented and has been carrying on extensive investigations in this industry in order to be able to supply the economic answers as new problems are presented to it.

Maintenance of Steel Mill Cranes . .

. . . . no quicker way could probably be found to shut down a steel mill than to effect a general crane stoppage . . . . consequently, constant and effective crane maintenance is required to prevent any interruptions to mill production . . . .

By A. J. F. MacQUEEN
Mechanical and Electrical Superintendent
Atlas Steels, Ltd.
Welland, Ontario, Canada

▲ CRANES are the almost universal method of handling materials in the steel industry. Perhaps the significance of this fact is sometimes overlooked, but when it is remembered that the 85,000,000 tons of steel produced per year is all handled by cranes, mainly in small lots of 5 to 20 tons, as many as 30 or 40 times in the process of production, the magnitude of the handling job done by cranes can be appreciated. In fact, without cranes the steel industry, as we know it, simply would not exist.

The term "crane" is a general one applied to a variety of equipment such as overhead traveling cranes, boom cranes, jib cranes, gantry cranes, monorails, and is even applied to such things as open hearth charging machines. Each of these has its own peculiar problems of maintenance. In the single general classification of overhead traveling cranes there are specialized types such as hot metal cranes, pit cranes, ingot strippers, etc.

There are literally thousands of cranes in the steel industry. The little data available would seem to indicate that there are on the order of fifteen to twenty thousand overhead traveling cranes alone. Their ages vary from newly-installed to 30 or 40 years. Their capacities vary from a matter of a few pounds to 400 tons or more. Their traveling speeds may be anything from 10 to 600 or more feet per minute.

There really is no such thing as a standard crane. Each crane is designed to do a specific job, and to fit into specific processes, and should therefore be considered as an integral part of production equipment rather than as an accessory or auxiliary piece of apparatus. The vital part that cranes play in the steel industry is indicated by the reluctance of operating people to release a crane for servicing, and the pressure put on the maintenance department when a crane is out of service due to a breakdown.

A paper on "Crane Maintenance" that would completely cover the ground would have to take note of the problems peculiar to all the various special types of cranes mentioned, and would be a tremendous undertaking. This paper, therefore is limited to 3 or 4-motor, 4-wheel, general service, direct current, overhead traveling cranes of 5 to 30 tons capacity with spans ranging from 50 to 100 feet.

Possibly one-half the number of overhead cranes in the industry fall in this class, and although some of the others do have more complicated mechanisms and are different in size, the principles involved in maintenance of general service cranes are applicable to all types.

The paper is roughly divided into two parts, the first being a discussion of maintenance methods in general, followed by some discussion of specific crane maintenance problems, avoiding such items as motor maintenance which are not exclusively crane problems.

GENERAL MAINTENANCE METHODS

It is obvious that cranes, which are such an important item in the machinery of production, must be maintained in good operating condition at all times. The AISE has published standard specifications for electric overhead traveling cranes, developed with a view to continuity of service and a minimum of maintenance. And there have been many papers published in the *Iron and Steel Engineer* dealing with cranes, but an examination of this literature shows that, while there are many references to maintenance matters, the major portion of it deals with crane design and is not always helpful to the maintenance man who is dealing with cranes already designed, built and operated. And where the work has to be done with cranes of varying degrees of obsolesence, the problem of maintenance becomes more difficult.

There are certain characteristics common to all cranes which it is well to bear in mind when considering crane maintenance.

The first of these is the severity of the service, the

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outstanding factor here being shock loading of all component parts of the crane, a factor which even yet is not always fully appreciated.

Cranes are a variety of rolling stock. They can be considered as railroad cars or locomotives with an extremely short wheel base and an extremely wide track gage. Obviously the difference in these proportions introduces problems of alinement which are entirely absent in standard railroad equipment.

Cranes differ from other rolling stock in another respect. The wheels are not spring mounted, which emphasizes the matter of shock loading. Incidently, a spring suspended end truck has been developed, but has disadvantages which have prevented it from becoming popular.

Crane track wheel loads are always high. A paper published in the 1940 Proceedings of the Association of Iron and Steel Engineers quotes figures indicating that crane wheel loads run to two or even three times railroad locomotive wheel loads.

Maintenance methods — Good maintenance of cranes begins with proper systematic inspection, following an established routine. This basic fact cannot be emphasized too much. The next step is the expeditious handling of repairs and replacements which are planned as a result of the data obtained by inspection. This combination of systematic inspection and planned repairs is essentially what is meant by "preventive maintenance."

This method requires a well-trained organization, with the responsibilities for the various phases of the work definitely delegated to specified individuals, and clearly understood by all concerned. Nothing is more detrimental to good maintenance than confusion as to who of several people is responsible for a given part of the program.

The sort of organization developed to obtain preventive maintenance will vary from plant to plant. In many plants the electrical department has complete charge of cranes, but in others they do not. In some plants the electrical department has charge of crane operators and in others they do not. In some instances crane maintenance is taken care of by the motor inspectors assigned to the area. In other cases crane maintenance is the sole function of a specialized group.

The particular form of organization is a matter for each plant to determine to suit its own conditions, and any of various organizations will function equally well provided the basic requirements of regular systematic inspection and repair and the clarification of responsibility are adhered to.

Arranging for systematic inspection is quite often a problem, due to the fact that cranes are frequently so busy the production departments are unwilling to grant the necessary time for inspection. However, it is to the advantage of the production departments to keep the cranes operating, and a pre-arranged short, down time for regular inspection seems a small price to pay to prevent unexpected and costly major breakdowns. If the operating departments and the maintenance department approach this problem constructively, ways and means can always be arranged to solve the problem to mutual satisfaction and benefit.

No general rule can be set up as to frequency and coverage of inspection. The status of each crane must be determined by its own special circumstances. But once determined, inspection should be set up as a routine and incorporated in the general scheme of maintenance.

Records — The keeping of records is an essential part of a planned maintenance program. Records are necessary to properly determine the frequency of inspection and to determine the quantity of spare parts to maintain safely and economically.

Records are the means by which an already established planned maintenance program can be checked and modified to fit the conditions realistically. There must be a balance kept between too little inspection on the one hand which makes planning impossible, and too much inspection on the other hand which is simply a waste of time and money.

Records indicate not only weak spots in the program, but also weak spots in the design and operation of the crane, and are the guide to advantageous changes in design or material, and they are the check on comparative results when such changes are made.

The starting point for all records of this kind are the foremen's shift reports. From such reports the necessary data can be transferred to a permanent record. The simplest form of such record, and a very useful one, has a card for each crane with the pertinent identifying data at the top and chronological one-line entries showing the date, the job done, and the foreman in charge. This simple form of record can be built up and elaborated on to any extent desired, with complementary separate records for cables, motors, etc. For effective results the record system should be as simple as possible compatable with the circumstances.

Planning of work — The actual work of repairing cranes, replacing worn parts, etc., as is shown to be necessary from inspection, should be planned well in advance. The time of taking a crane out of service for such work should always be by arrangement with the operating department concerned, in order to have the work done when the down time will least affect production. All parties involved in the repair job should have ample notice of the time it is planned to start the work. All tools and equipment needed for the job should be assembled ready for use before work actually starts, and the work should be done in the most expeditious manner possible so as to reduce the crane down time to a minimum.

When planning repair work or changes to improve the service life of crane parts, consideration should be given to the possibility of standardizing parts. Standardization can simplify and reduce maintenance work and the supply of spares necessary.

Training of personnel — A well trained personnel is essential if an intelligent program of systematic preventive maintenance is to be translated from a project on paper to a reality.

Definite, conscious and continuous coaching and training down through the organization is the only sure means of attaining the intended results, and the important word here is "continuous." It just is not possible to hire a good maintenance man, regardless of his ability or experience, because preventive maintenance in steel mills is not a matter of the individual's ability alone, but is also a matter of having the individual fit into a close-connected smooth-working organization. It is usually a matter of months at least before even a

high grade experienced electrician or mechanic becomes a good steel mill crane maintenance man.

Courses of study, such as a series of regular meetings, night classes, etc., can be helpful for training purposes, provided that they are held under competent leadership with groups small enough to be effective, and provided further that they are made specific as possible and not allowed to deteriorate into vague generalities. But the most effective training is the daily round under the supervision and coaching of experienced forward-looking foremen.

SPECIFIC CRANE PROBLEMS

Lubrication — Lubrication is one of the most important considerations in good crane maintenance. Good lubrication is a matter of applying the right lubricant in the right amount at the right time. There has been a tremendous development in lubricants in recent years, and there should be no great difficulty in determining the proper lubricants. The quantities and frequencies of application usually have to be determined on a trial and error basis to some extent; but once these things are determined, lubrication becomes a matter of setting up a schedule routine.

The same sort of problems are met here as in setting up inspection schedules, and can be solved in a similar manner. The actual lubricating can be done either by crane operators or by various maintenance men, and arrangements in this respect can vary from plant to plant, from department to department, and even from crane to crane. The important thing is to have the lubricating done according to a planned program under qualified supervision.

Manually operated centralized grease systems, where all bearings are lubricated from one location on the crane, are in extensive use and have certain advantages. The use of them eliminates the hazards of climbing over the cranes and gives some assurance that all bearings are getting the right amount of lubricant, including the less accessible ones which are often overlooked when being hand greased. This is of particular advantage on cranes with sleeve type bearings. On anti-friction bearing cranes, the advantages of the centralized system are not so apparent as the intervals between applications of lubricant are much longer and it becomes easy to fit the lubrication into the inspection schedule.

Runways — Since cranes run on rails it follows that a good track or runway is necessary to minimize crane upkeep. It is now generally accepted practice to install new runways with the rails thermit welded into one continuous length. Most of us have runways to contend with which were installed without much thought to maintenance. The rails are fastened to the girders with hookbolts or clamps and standard railroad type splice bars are used. In time, the continuous heavy wheel loads cause the rails to creep, gaps up to ½ in. or more appear at the rail joints, and the rail ends get hammered down. Even though this is a familiar condition, it has not always been recognized as a major source of trouble in the way of broken wheels, bearing failures, broken resistors, and general deterioration of the crane.

Various means of overcoming this condition can be employed. Welding is used to a large extent. There is considerable data available on the subject, and acetylene, thermit and arc welding are in use, with the acetylene method appearing to be the most popular. Thermit welding is at a disadvantage for track repair work due to the awkwardness of setting up such a weld on the runway, and the short repair time usually permitted.

An alternative method that has proved quite successful is to machine the rail ends at a 45 degree angle and install the rails with matched ends using special splice bars and fitted bolts.

Another method that is reasonably successful provided the rail ends are not too badly battered is to jack the rails solidly together, grinding them where necessary to get a good butt joint, and then welding stop blocks at both ends of the runway to prevent creepage. Repairs of this nature are a difficult problem in most plants as the crane service requirements limit the availability of the runway for repairs, and usually such repairs must be done on a piecemeal basis.

Runways, particularly long ones, frequently become out of line through working of the building steel, although the track gage remains fixed. Such a condition usually results in excessive wheel flange wear and wear of rail heads. To take care of this, tapered tread wheels were developed and have proved to be extremely useful. There are limitations to the use of tapered tread wheels. The end trucks must be capable of accommodating a wide tread wheel (usually 1½ in. wider than the rail head) and there must be clearance enough between end trucks and building steel to permit the crane to float.

Frequently the runway rails used are too light. Standard rail sizes have been established but have not always been followed by the building designers. The wheel loads are known, but the factor usually overlooked is the frequency with which the loads travel back and forth over the rails. From this point of view crane rails are called on to stand up to service comparable with busy railroads. Also cranes are frequently added after the original installation. The building steel gets checked, and strengthened if necessary but the rail is left undersize. The only remedy for this condition is the replacement of the rails by heavier ones.

Collector systems — Collector systems for cranes can be a serious source of trouble. There has been a steady development along this line over a period of years in an effort to eliminate maintenance difficulties, and there now are collector systems on which maintenance has been reduced to a nominal amount.

It has been found that copper trolley wires, either tight or slack, and operating with either wheels or sliding shoes, were inadequate for steel mill service, and rigid conductors with heavy cast iron shoes are preferred.

For main runway collectors it has been found that rails welded into one continuous piece and mounted rigidly on porcelain insulators give best results. Copper cable is used in parallel with the collector rail for high current values or for extremely long runways. The collector shoes are cast iron with generous contact surfaces and depend on weight for proper contact pressure.

For crane collectors, bars or angles are usually used. The inverted angle type has some advantage in the

way of continuously maintained contact and is probably the most trouble free. Wood (dry hard maple, if obtainable) is commonly used as an insulator, and is generally adequate, but porcelain insulators for this work have been developed and are also in use.

Older collector systems which are found to require undue attention should be replaced with a better design. This can usually be arranged with little interruption to service.

Track wheels — There is no part of the crane, except manual controllers and cables, which require more attention during its life than the bridge track wheels, shafts, and bearing assemblies.

There are two types of wheel assemblies in general use, those with the wheel and drive gear revolving on a stationary axle, and those with the wheel and gear mounted on a revolving axle. Plain and anti-friction bearings are used with both types. The trend in recent years has been toward the use of anti-friction bearings. But if changes from bushings to anti-friction bearings are contemplated, it is imperative that bearings of an adequate size are used, and that they are assembled with no misalinement. Practically all bearing failures can be attributed to disregard of one or both of these conditions, or to improper lubrication.

Wheel bearings must be capable of withstanding two severe conditions, namely, extreme pressure and shock load. The earlier anti-friction bearing applications did not take these sufficiently into account. On the other hand plain bearings can take a lot of abuse, and some plants which favor anti-friction bearings elsewhere on the cranes prefer plain bearings for track wheels. However, anti-friction bearings of the sizes now employed are adequate. The best arrangement seems to be a double tapered roller bearing on one end of the wheel axle and a straight roller on the other end.

In the assembly and installation of track wheels with anti-friction bearings, the maintenance man has full control of fits and alinement. The care required should be emphasized. For example, pressing the gear on the hub of a track wheel may distort the bore of the hub sufficiently to harm the bearing which goes inside, and machining after assembly becomes necessary.

On cranes which have the final gear reduction at the drivers, squareness of the crane has little bearing on the wheel alinement. On cranes which have all the reduction at the center of the bridge, and the lineshaft coupled to the wheel shaft, squareness of the crane is important. If the crane gets out of square, bending stresses are imposed on the wheel shafts and the bearing loads are increased. If the wheel shaft couplings are permitted to work loose, thrust loads are also imposed on the wheel bearings. A consideration of this problem indicates flexible wheel shaft couplings as a possible solution. This has been tried out with success.

Wheel shafts, at least on the more recent cranes, are adequately designed. However, breakages do occur, and in almost all cases can be traced to the lack of a radius at the point where change of shaft diameter occurs. It is a small point, but important and too frequently overlooked by both designers and shop men.

Crane bridge track wheels are generally made of forged or rolled steel with a 0.40 to 0.50 per cent carbon content. The AISE crane specifications call for 0.70 per cent carbon. It has been found that cast iron wheels are inadequate for this service, and cast steel wheels are definitely inferior to rolled wheels.

Wheels, heat treated after machining, and wheels with flame hardened treads are in use. Generally speaking, it seems doubtful whether such wheels have any economic advantage over standard wheels except under unusually severe conditions, where certain types of hardened wheels are quite successful. Conditions vary, however, and some plants find it advantageous to use hardened wheels on all cranes. Flame hardening has not been too successful, as it appears to be difficult to obtain uniformity of hardness and flat spots are apt to develop.

Mention has already been made of tapered treads. Best results are obtained from tapered tread wheels when the drivers only are tapered and held to a definite location in the end truck, and the idlers have straight treads and are free to float somewhat.

Bridge drivers should always be changed in pairs, matched for diameters, particularly in the case of flat tread wheels. With tapered wheels, some small difference in diameter is permissable.

Gearing — Gearing is another item of crane maintenance requiring some attention. In the case of newer cranes utilizing gear reducers with anti-friction bearings, and heat treated gears totally enclosed in one housing and running in an oil bath, the problem resolves itself mainly to one of simple lubrication. The open or semi-enclosed gears with which many cranes were originally equipped should be effectively enclosed wherever possible with good seals to prevent lubricant leakage and infiltration of dirt.

As a general thing, 20 degree teeth are preferable to 14½ degree teeth because of the shock loads, and straight spur gearing is preferable unless the matching gears are held in rigid alinement by anti-friction bearings. Gears and pinions are generally made of 0.40 to 0.50 per cent carbon steel. Heat treating of all gears after machining is common, but the economics of such a policy can be questioned in many cases. Flame hardening has been used with gearing but the same remarks apply here as in the case of track wheel treads.

There has been discussion as to the possibility of taking advantage of heat treating of gears and pinions to reduce the tooth size. Since the heat treating is generally intended to obtain wear resistance rather than strength, the wisdom of such a move seems doubtful.

Drums — Cable drums need to be changed occasionally due to wear of the grooving. Drum failures due to breakage of drum or shaft are rare, and can be disregarded for the purpose of this paper. Wear of drums can be minimized by using the right cable for the job, by having the right grooving for the cable in use, and by proper handling of the crane by the operator.

Heretofore most drums have been of cast iron, but cast steel is now in use. It has the advantage of more strength and can be reconditioned an indefinite number of times by welding and remachining the grooves. Iron drums can be turned down and have the grooves recut once at most, and then must be scrapped.

Steel drums lend themselves to surface hardening, but this has not as yet become a common practice. Flame hardening might be of advantage here as the

possible non-uniformity of hardness would not be such a serious objection.

Burden blocks — The maintenance of burden blocks and hooks resolve itself mainly into a simple problem of replacing a block which gives trouble with one of better design, and using the one so removed in some other location where it will be adequate. In most plants, standardization of blocks is possible and is quite generally in effect.

Cables — Improved plow steel cable in either 6-19 or 6-37 stranding and with either hemp or wire rope center is almost universally in use. The big problem in this connection is the proper inspection of cable condition to determine when the cable needs to be replaced. There are no fixed rules by which a cable can be judged, and such decisions must depend on the judgment and experience of the man inspecting. A partial guide to cable condition is the number of broken wires showing. For this reason most steel mill maintenance men prefer standard cable to the preformed type in which broken wires are difficult to detect.

Limit switches — Crane hoist limit switches should always be of the type which acts directly on the motor circuit. Limit switches which act on the control circuit are much less reliable. The practice on the part of the operator of depending on the limit switch to stop the lifts in normal operation should be discouraged. Limit switches should be considered as emergency equipment only.

Brakes — Bridge brakes on the newer cranes are hydraulically operated. Hydraulic brakes are much superior to any type of lever or cable operated brakes, both in operation and with regard to maintenance. Lever or cable operated brakes should be replaced by hydraulic brakes on all cranes, except possibly those which are used infrequently, such as motor room cranes.

For the hoist motion, dynamic braking, plus magnetic shoe brakes, is the accepted standard on all steel mill cranes. Mechanical load brakes have been found to be less effective than dynamic braking and are invariably a constant source of high maintenance costs and they should be eliminated.

DISCUSSION

PRESENTED BY

A. J. F. MacQUEEN, Superintendent Maintenance and Service Department, Atlas Steels, Limited, Welland, Canada

A. LINKE, General Mechanical Foreman, Dominion Foundries and Steel Company, Hamilton, Ontario, Canada

W. A. TAYLOR, Superintendent of Maintenance, Dominion Foundries and Steel Company, Hamilton, Ontario, Canada

RUDOLF E. KNORR, General Crane Foreman, Bethlehem Steel Company, Lackawanna, New York

H. E. DAVIS, Superintendent of Maintenance, Republic Steel Corporation, Buffalo, New York

D. W. McLEAN, Assistant General Master Mechanic, Steel Company of Canada, Limited, Hamilton, Ontario, Canada

C. G. DAVIS, Chief Electrician, Vanadium Corporation of America, Niagara Falls, New York

Member: In your opinion what are the relative merits of control button over push button control as far as maintenance is concerned?

A. J. F. MacQueen: For the type of crane that I was discussing here in the paper it is not customary to use either. The sort of cranes that I was talking about are usually fully magnetic control with mill type masters, and drum, or faced type, plating manual controllers in the case of older or smaller cranes. I am afraid that I am not quite qualified to answer your question.

Member: Do the crane runways expand the same as the rail does?

A. J. F. MacQueen: That is a question that has been asked a good many years. The consensus of opinion seems to be that in the expansion and contraction of the rail and the building, there is not enough difference to have any practical effect. In other words, the rail actually does expand and contract pretty much with the building, and there has been considerable welding of crane rails with apparently very successful results.

A. Linke: How does cable wear stand up in steel drums in comparison with cast iron?

A. J. F. MacQueen: On a straight steel drum without any hardening, as far as I have heard there is no particular difference in the cable wear.

W. A. Taylor: I would like to know from a maintenance point of view if there is trouble with operators plugging the motor? What do you do to stop that?

A. J. F. MacQueen: If you have magnetic control you are all right, for you can limit the plugging. If you have manual controllers I do not know what you can do except train the operator.

Rudolph Knorr: Mr. MacQueen's interesting paper is based on direct current general purpose electrical overhead traveling cranes from light to medium capacity and normal bridge span.

Let us consider some methods which would be helpful in simplifying maintenance work.

1. For every crane in a plant there should be a complete set of detail drawings kept in the office, showing the general arrangement of bridge and trolley, length and diameter of hoisting cables, and information on maximum wheel loads.
2. A set of detail prints for all wearing parts should be kept in the work shop, such as:
   a. Bridge: Drivers, idlers, end sections and middle section for lineshafts, truck and lineshaft bearings or bushings.
   b. Trolley: First gear reduction, drivers and idlers, and the required bearings.
   c. Hoist: The first and second gear reduction with bearings.
3. Keep required wearing parts on hand to be prepared for breakdowns.
4. Replace your used up spare parts or keep raw mate-

rial on hand to be prepared for the next breakdown.

If repeated breakdowns develop, check the field conditions and analyze the original specified material to see if specifications can be changed or if layout can possibly be altered.

A continuous contact with the operators and mill people and a satisfactory inspection will give the variations of opinion among operators. This should be settled on basis of best condition. A printed form should be handed to the operator starting each shift which he is to make out, and turn into his foreman showing condition of equipment and results of operation. The form should have:

Date.....
Turn.....
Crane No.....
Main Hoist Limit Switch.....
Auxiliary Hoist Limit Switch.....
Main Hoist Cable.....
Auxiliary Hoist Cable.....
Windows.....
Time Oiled.....
Time Repaired (Minor Item).....
Fire Extinquisher.....
Electrical and Mechanical Condition.....
.....
.....
.....
Check Number.....Name of Operator.....

The oiling and greasing in our plant is handled in three ways:

1. In most places the operator takes care of oiling and greasing.
2. An oiler takes care of the hot metal cranes and in mills where such setups are required. The decision is left to the department superintendent.
3. The motors are lubricated entirely under supervision of mill electrical foreman.

On modern cranes centralized lubrication systems are installed; on older cranes the hand grease gun is used on hoist, trolley and bridge lineshaft bearings. On the bridge truck and trolley bearings, oil soaked wool waste or felt is used for lubricating the axles.

It is very important that in flow of production material, the layout is such that the receiving cranes are as large as cranes preceding it. For example a bad layout occurs where the crane in the finishing end at the blooming mill has a 25-ton capacity and the receiving crane in a smaller mill only 15-ton capacity.

The blooming mill is interested only in handling billets with the least amount of work and equipment. The 15-ton crane has to handle a continuous overload, and a short life of the crane can be expected. Here then, continuous inspection is necessary. These weak spots have to be known to the maintenance department and special attention has to be given to them.

Frequent inspection and proper planning will minimize the breakdowns and will eliminate shutdowns on operating units.

H. E. Davis: I am heartily in accord with the author's remarks that the condition of the runways are responsible for a great deal of the maintenance costs on overhead cranes. The author has brought out that runway rails are too light. I believe most of us are faced with this same problem which has been brought about by having cranes 20 or 30 years old operating on skeleton type runways. Then due to increased production, we installed modern cranes with heavier wheel loads and higher speeds on these same runways. In some cases the structure of the runways had been strengthened, and no attention given to increasing the size of the rails. Consequently, we have bad rail joints and these battered rail joints cause broken wheels and broken bearings, constant adjustment to control boards, etc. Trying to maintain tight rail joints and proper rail alinement becomes almost a constant week-end job of either driving the rails together, or changing a section or two. All of which in my opinion are make-shift remedies, since far better results could have been obtained by starting out with oversize runway rails. I believe that proper designed crane runways with proper size or oversize rails will cut maintenance on overhead cranes to the same extent that the maintenance on automobiles was cut when modern highways replaced the old time roads.

Member: What happens to the rail when you have tapered wheels?

A. J. F. MacQueen: The taper is used, I believe, on anything less than 175 pound rail. The taper fits approximately the slant on the one side of the rail head, since the rail head is not absolutely flat, and on the rails you have an off-center loading. Wear occurs on one side of the head; on which there is a loading that you do not get on a straight rail. There is also a certain amount of side thrust. As far as I know, there have been no bad results on crane runways from that fact, and, as a matter of fact, if the rail were to continue to wear until it finally met the contour of the wheel, it still would be all right in operation.

D. W. McLean: I have two questions in connection with the tapered wheel discussion. You emphasize your tapered wheel should be fairly rigid. What do you do with the floating wheel that is on a gear-type wheel, where part of the reduction is on the wheel? Do you put a taper on there? Our experience has been you do not wear the rail so much, but you wear the flanges.

I would also like to get some ideas in connection with safety in crane maintenance; for it strikes me that it is the most dangerous maintenance work in the mill. It leaves a wide scope for further development of safe methods for making repairs on wheels and on that sort of stuff.

A. J. F. MacQueen: On the matter of tapered tread, what did you have in mind, the fixed pin type of wheels?

D. W. McLean: Yes.

A. J. F. MacQueen: To get proper results out of the tapered tread on that type of wheel, the two drivers should be tapered and the drivers washered closely so that they will not move sideways with relation to the end truck, and at the proper span for the track gage. The two idlers should be left free to float and should have a straight tread. You depend then on the two drivers to do all the work of alinement, and the idlers simply float along and carry the load. If it is handled that way and there is clearance on the building columns, you can run that crane for five years, and you will not get anything more than a few small rub lines on the

wheel flange. Under those conditions, they are really effective.

To comment a little more on your remarks regarding safety in crane maintenance, you are quite right. We are not as far along as we should be. The more recent cranes carry such things as safety platforms all the way around, and walks on the bridge, and working platforms on the wheels; but there are a good many older type cranes which do not have these items. Sometimes the design is such that you can do something on the crane along that line. Sometimes the design is such that it is a pretty tough problem to do anything.

We had such a problem some time ago in our plant where we were criticized by the Department of Labor. It was finally solved by having the men working on that job wear safety belts with enough slack so that they could strap themselves to the crane to give themselves room to work, but still short enough that if they did slip, they would not fall any more than about a foot or two.

C. G. Davis: I would like to ask what kinds of wheels give the best service, rolled steel wheels, or the tool steel wheel?

A. J. F. MacQueen: The tool steel wheel, rolled steel, and cast steel in that order. The cast steel wheel being the poorest. Whether it is economically better to use tool steel wheel than the rolled steel is another question, and depends upon particular circumstances and particular installation or operating conditions and that sort of thing, but on just a straight question as to which wheel will give the longest service, tool steel is the answer.

Member: What are the latest developments relative to protecting an operator subjected to heat or flame working in a cab?

A. J. F. MacQueen: The latest development, as far as I know, is an air-conditioned cab. I saw one of them at the Association of Iron and Steel Engineers' Convention last fall and looked it over as much as I could. As to flame, I do not know of any crane cabs that are ordinarily subjected to a flame condition, but they are subjected to heat. I think the answer is an air-conditioned cab, but to put an air-conditioned cab, on some of the cranes we have, would be to gild the lily a great deal and usually the expense involved simply cannot be justified.

Design of All-Basic Open Hearth

. . . . experience with all-basic open hearths indicate that marked maintenance economies are possible by their use . . . . consequently the detailed design described here is of more than passing interest . . . .

▲ A REBUILT 122-ton open hearth furnace at the South works of Carnegie-Illinois Steel Corporation, a subsidiary of United States Steel Corporation, located in South Chicago, Illinois, features the use of basic refractories for all parts of its masonry construction exposed to high temperatures, with the exception of the walls and roofs of the checker chambers, the checker brick, floors and bulkheads of the slag pockets, and the roofs of the fantails.

Designed as an experimental furnace for use under commercial conditions to determine the economic and metallurgical advantages obtainable from a basic lining, it will also be used to study the application of oxygen as a combustion supplement. In addition it will provide an opportunity for comparing the characteristics of various kinds of refractories. Experiments will include the use of oxygen in different kinds of burners, and the use of preheated compressed air for atomization of oil. Studies will be made of flame radiation, effects on furnace efficiency of the higher temperatures permissible with basic linings, and of possible new steelmaking procedures.

All available data relating to the use of basic refractories in open hearth furnace construction were carefully studied and correlated to evolve a furnace design

Each of the metal hangers, of the main roof arch, accommodates two tile, which can be removed at any time without disturbing the remainder of the roof structure.

appearing to offer the simplest and safest solution to the various problems inherent in the use of basic brick. By using refractories of the same nominal types, but from different sources, it is intended to compare the characteristics of the several types as influenced by their compositions and methods of manufacture. This part of the investigation was furthered by using similar brick from different sources in comparable parts of the furnace.

The following tabulation presents the main dimensions of this experimental furnace:

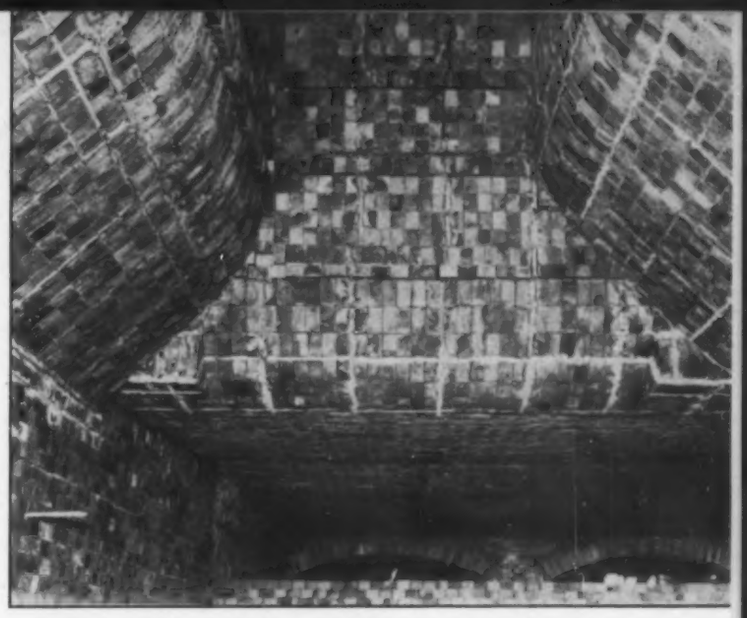
GENERAL DIMENSIONS

Hearth dimensions (at foreplate level, inside of brickwork):	
Length	38 ft 0 in.
Width	14 ft 3 in.
Depth of bath	36 in.
Height to spring line of main roof:	
Front	5 ft 2 in.
Back	4 ft 4 in.
Offset in sloping back wall	8¾ in. per foot
Slope of back wall	54 degrees
Span of main roof	17 ft 1½ in.
Rise of main roof	2 ft 2 in.
Distance, charging floor to top of foreplate	2 ft 9 in.
Number of charging doors	5
Dimensions at throat or knuckle:	
Width (at base)	10 ft 3 in.
Width (at top)	12 ft 3 in.
Distance, center of knuckle to uptake heel	5 ft 0½ in.
Width of port ends — (outside to outside brickwork)	16 ft 3 in.
Number of uptakes (each end)	2
Length of uptakes	5 ft 8 in.
Width of uptakes	4 ft 10½ in.
Combined area of uptakes (each end)	66.6 sq ft
Height of air bridgewalls above foreplate	3 ft 3 in.
Distance from roof knuckle to outside of end wall	11 ft 11 in.
Slope of port roof	10 degrees
Distance knuckle to knuckle	37 ft 8 in.
Length of furnace (outside to outside brickwork)	61 ft 6 in.

Refractories — Basic refractory brick and shapes used in building the masonry of the furnace were obtained from three independent sources and comprise five kinds. They include: metal-encased and plain chrome-magnesite brick of the chemically bonded type; burned chrome-magnesite brick, some of which are encased in metal after burning and some intended for use with loose metal plates. In addition to the basic brick there are two grades of firebrick — a double burned super duty brick, and a first quality firebrick. Insulating brick is also employed along with insulating cement and concrete that serve the double purpose of insulating and sealing masonry surfaces. The locations where each type of refractory or insulating material is used will be mentioned in describing the construction of the various parts of the furnace.

Roof construction — Suspended arch construction was adopted for both the main and the port roofs of this furnace. A movable and rotating skewback, backed by springs, takes care of the expansion, contraction, and growth of the roof brick which are quite different from those of silica roof brick. (This is one of the first installations employing both suspension and springs.) The main roof was installed 8 in. higher than the silica roof it replaced.

Three types of refractory tile were used in the main and port roofs. At the south end of the furnace, the main roof was built of metal-encased, chemically-bonded chrome-magnesite brick containing approximately 60 per cent magnesite. The port roof at this end was built of a special grade of burned chrome-magnesite tile (45 per cent magnesite) used with loose plates between all bricks. The main roof is 37 ft 8 in. in length, knuckle to knuckle, and comprises 128 rings, or courses, of 15 in. tile, suspended in pairs from metallic hangers.



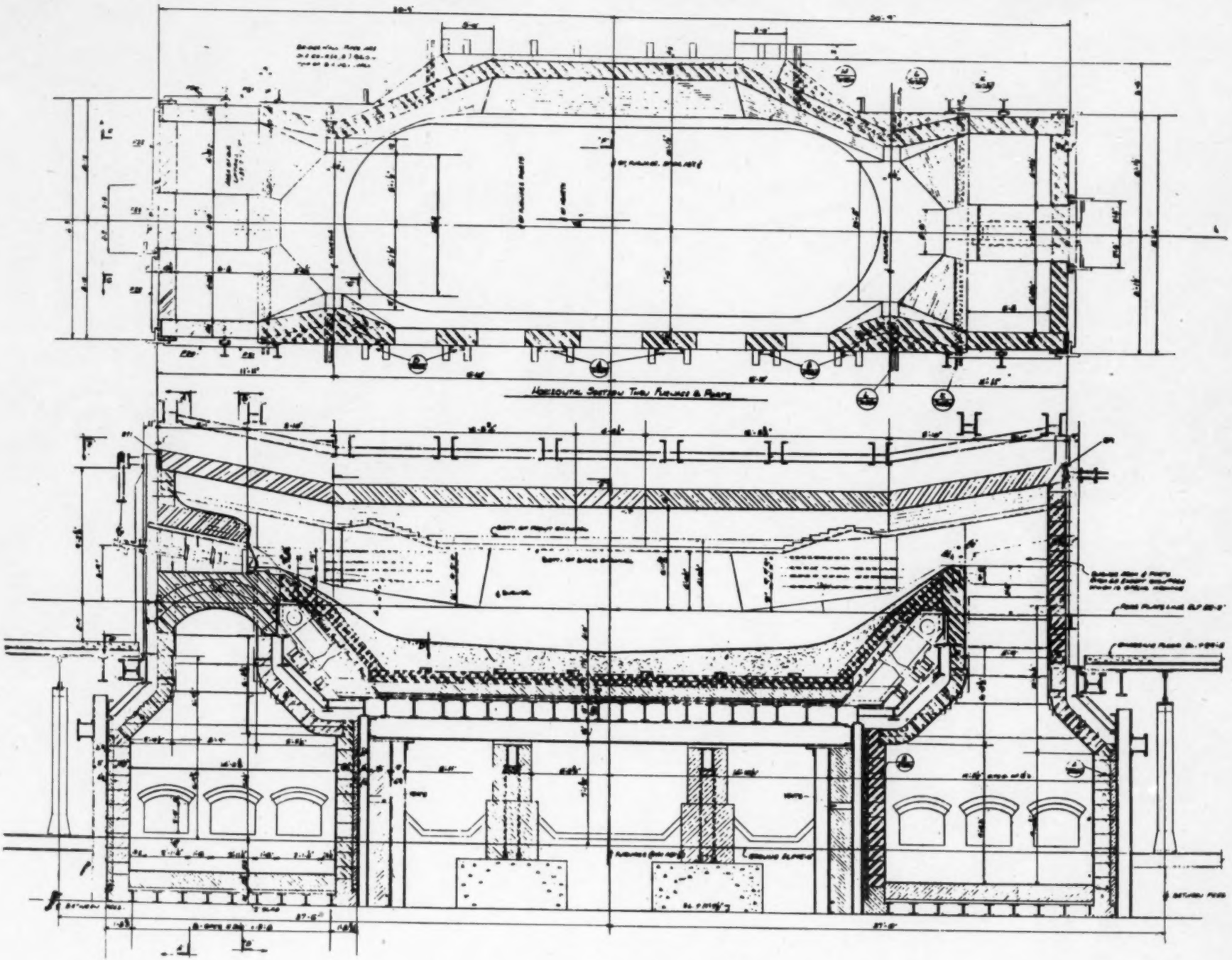
This view shows the uptake walls and upper part of slag pocket of experimental all-basic open hearth furnace.

These hangers are supported by small steel channels and I-beams formed into an arc extending across the roof of the furnace and hung from structural members supported by the furnace binding. The port roof at each end, also arched and similarly suspended, having the same inside radius as the main roof, is 11 ft 8 in. long, comprising 40 rings of 15 in. tile.

On the pit side of the roof, a series of powerful coiled springs bear against the movable skewback channels. The outside end of each spring bears against the furnace binding. This spring arrangement compensates for expansion, contraction and growth of the roofs (main and port). Altogether, there are sixteen of these springs which act in conjunction with the movable and rotating skewbacks. Expansion joints provided in installing the roof tile are ⅛ in. wide every fourth course in the case of transverse joints. In addition, there are eight ½ in. longitudinal joints in the main roof and six in the port roof.

A 4 ft 8 in. wide strip of roof in the middle of the furnace is constructed of a special grade of refractory tile, identified as a hard-burned, chrome-magnesite type (40 per cent magnesite). This grade is said to be characterized by unusually high resistance to deformation and to absorption of iron oxide, and has been applied only in this location.

Approximately 9400 tile were used in the main and port roofs, including about 750 special tile installed in the middle of the main roof. Construction of the roof at the north end was carried out in the same manner as at the south end, with the exception that the application of the two grades of roof tile were reversed:



Longitudinal section through centerline of furnace.

that is, the grade of tile used in the main roof of the south end was used for the port roof of the north end; while the grade of tile used for the port roof at the south end was used to construct the north end of the main roof.

The suspension of the roofs permits replacement of individual tile or sections at any time without disturbing the remainder.

Bottom construction — The hearth is the same as in the original furnace, except that it was carefully repaired to assure soundness. The pan is of ⅝ in. steel plate. The first or bottom course consists of 2½ in. of insulating brick laid on 1 in. of insulating concrete. The second course consists of 9 in. of first-quality firebrick; the third course consists of 9 in. of plain, chemically bonded, chrome-magnesite brick containing approximately 70 per cent magnesite; the fourth and last course consists of a layer of monolithic bottom material, basic in chemical character and 17½ in. thick at the center of the hearth.

Front and back walls — That portion of the brickwork from the sill or foreplate up to the bottom of the front skewback channel forms the front wall of the furnace. In this wall are the five doors. The furnace is equipped with water-cooled, archless door frames. The masonry from the top of the back hearth castings to the channels of the movable and rotating skewback forms the back wall of the all-basic furnace. Metal-encased, chemically bonded, chrome-magnesite brick containing approximately 70 per cent magnesite were used to build the front wall and the sloping back wall. The front wall is laid up with ¼ in. metal plates between every fourth course which are hooked onto bars welded to the sides of the front buckstays. Thickness of the front wall is 13½ in. from a point 15 in. above the floorplate. The back wall is 18 in. thick. Starting 15 in. above foreplate level, the back wall consists of 13½ in. of the chrome-magnesite brick mentioned above, backed with 4½ in. of first quality firebrick. The back wall is faced with a mixture of magnesite and cement.

Port ends — Wing walls on either side of the roof knuckle form the area of greatest restriction to flow from the ports. This area of greatest restriction is known as the throat of the furnace. The wing walls are heavy at their bases and are tapered back as they go toward the roof. The hearth sides of the wing walls are water-cooled by 1 in. extra heavy pipes built into the brickwork, to aid them in maintaining their shapes during furnace campaigns. All wing walls consist of alternate courses of 13½ in. and 18 in. (two 9 in. courses), of metal-encased chrome-magnesite brick, with a 4½ in. stretcher course in front of the cooling pipes. The metal-encased wing walls were backed with plain brick of the same refractory grade.

The tops of the air bridge walls are water-cooled by pipes inserted one course (3 in.) below the top of the wall.

Burner arch and port — The burner port arch at each end of the furnace was built of chrome-magnesite brick using a 9 in. thick upper ring and a 13½ in. thick lower ring, (both rings being bonded) for the sprung arch. Plain burned brick were used for the south end burner port arch in conjunction with loose steel, No. 22 gage plates, laid between courses in 13½ in. ring only. Chemically bonded, metal-encased, chrome-magnesite brick were used at the north end. The burner port, or "doghouse," resting on the burner arch at each end of the furnace was constructed of the same refractory materials as the corresponding arch, and has an overall width of 3 ft 9 in. The walls are 13½ in. thick. The paving over the burner port is 15 in. thick, topped with 2 in. of chrome ore. From the outside of the end wall to the nose of the burner opening is 6 ft 1 in. The burner for each end of the furnace is inserted through the end wall into the passageway through the doghouse, and is thus protected from radiation and contact with furnace gases.

Uptakes — Construction of the uptakes employed metal-encased, chemically bonded chrome-magnesite tile having approximately 70 per cent magnesite. The tile were obtained from two different sources, the uptakes at one end of the furnace being built entirely from one type, with the uptakes at the other end being built entirely of the second type. This will provide comparative data on service behavior of the two types.

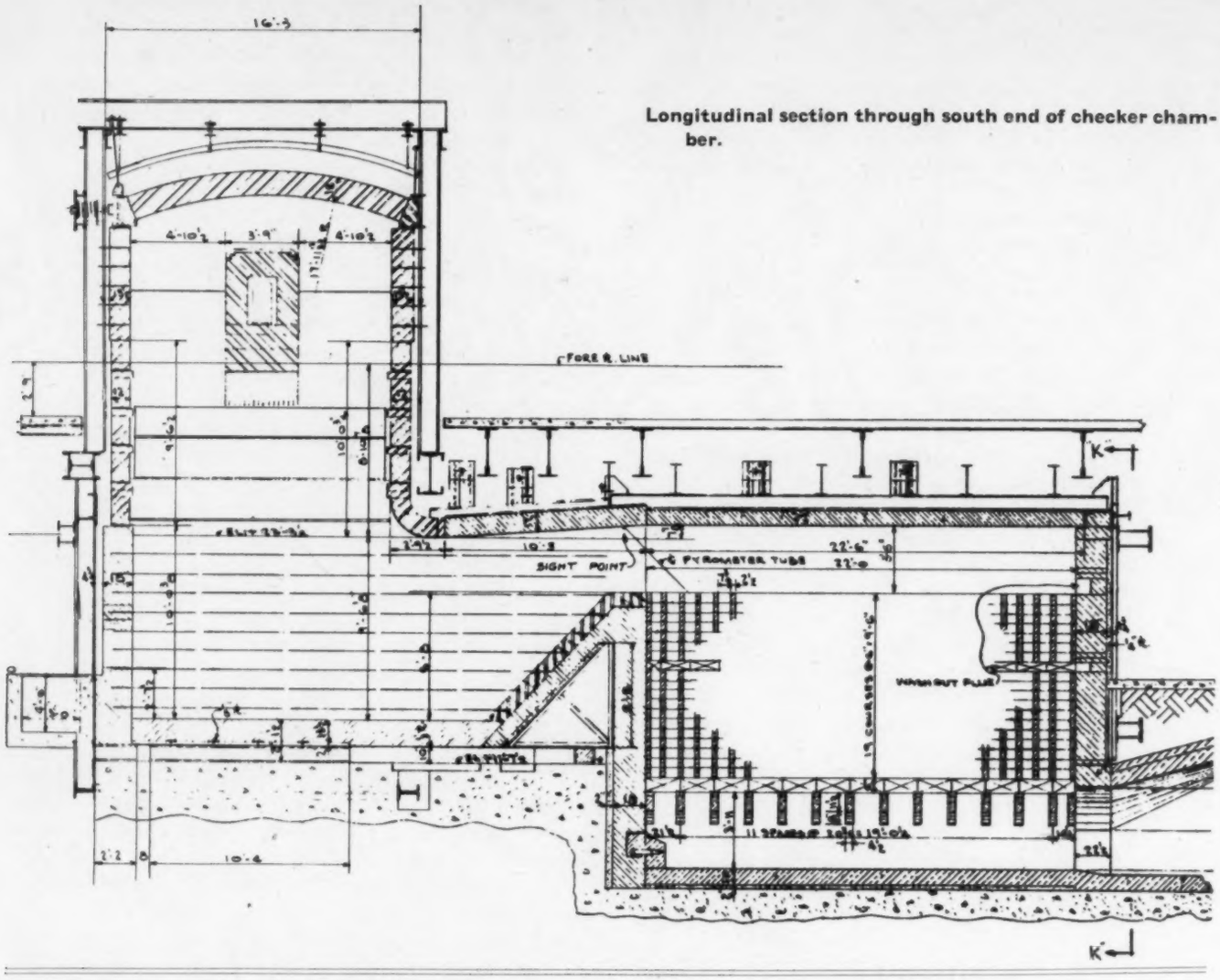
From the port roof down to 14 in. above the foreplate level the uptake walls (end, floor and pit sides) are 13½ in. thick. They are supported by ¼ in. steel plates laid horizontally between every fourth course and hooked onto the port buckstays. Below this level the walls are of suspended construction and are composed of 12 and 13½ in. tile, down to the top of the slag pocket. The end wall and the hearth-side wall of each uptake is undercut and overhangs the slag pocket. Groups of four 12 in. tile have their individual hangers attached to a steel plate that is hooked onto a channel on the steelwork of the binding. Between each group of four tile vertically, a 13½ in. × 4½ in. × 3 in. straight and a corrugated metal spacer are installed. The four-side uptake wall is built of 12 in. suspended tile in the same manner. Basic construction of the floor-side wall is continued around the bottom of the wall in a rounded corner or nose that extends 2 ft 9½ in. behind the face of the wall to meet the suspended roof of the fantail.

Slag pocket — The slag pocket walls are 18 in. thick composed of 13½ in. of basic refractory, and 4 in. of insulation, the basic wall being supported by ¼ in. steel plates laid horizontally between every fourth course and anchored to the binding. These walls are built of the same refractories as the uptake walls for the corresponding end. The slag pocket bulkhead is built of first quality firebrick, 18 in. thick.

First quality firebrick 13½ in. thick, were used to pave the slag pocket, which is 14 ft 0¾ in. wide and 18 ft 4½ in. long from the bulkhead to the bottom of the bridge wall. The floor of the slag pocket is air-cooled.

One of the characteristics of furnaces with ends built of basic refractories is that the deposit in the slag pockets is loose and granular and so high in iron-oxide content that it may be used as feed ore. For this reason three small bulkheads were built into each main bulkhead to provide openings through which the deposit could be raked out during operation of the furnace.

Checkers — The furnace originally had two checker chambers at each end for air, each of which had a sprung arch roof. When the furnace was provided with a basic lining, the division walls between the two checker chambers were removed, the outside walls were made higher, and a flat suspended arch was installed.



Longitudinal section through south end of checker chamber.

Checker work is 22 ft 0 in. long by 24 ft 0 in. wide. It is built of 19 courses of 6 in. wide tile, and is 9 ft 6 in. deep. There is a space of 3 ft 6 in. between the tops of the checkers and the roofs. The roofs are 9 in. thick, are built of double-burned super duty firebrick, and employ refractory hangers. Each vertical checker flue is 7¾ in. square. There are 25 vertical flues in the length and 27 in the width of the chamber. The checkers are basket weave, using 18 × 6 × 2½ in. brick.

The checker brick rest on 3 × 9 in. tile, either 20 or 21 in. long. The rider arches supporting the checkers rest on 9 in. wide walls. The five rider flues beneath the checkers are each about 4 ft 0 in. wide. Side walls of the checker chambers are 22½ in. thick, and the bulkheads are 18 in. thick, first quality firebrick being used to build both. The side walls are insulated with 4½ in. of insulating brick, and are jacketed with ¼ in. steel plate. The bulkheads are insulated with 1½ in. of insulating cement. The suspended roof of each checker is sealed with ½ in. of insulating concrete which in turn is covered with 1½ in. of insulating cement. Checker chamber floors consist of 10 in. of third quality firebrick laid on a 2 in. insulating pad.

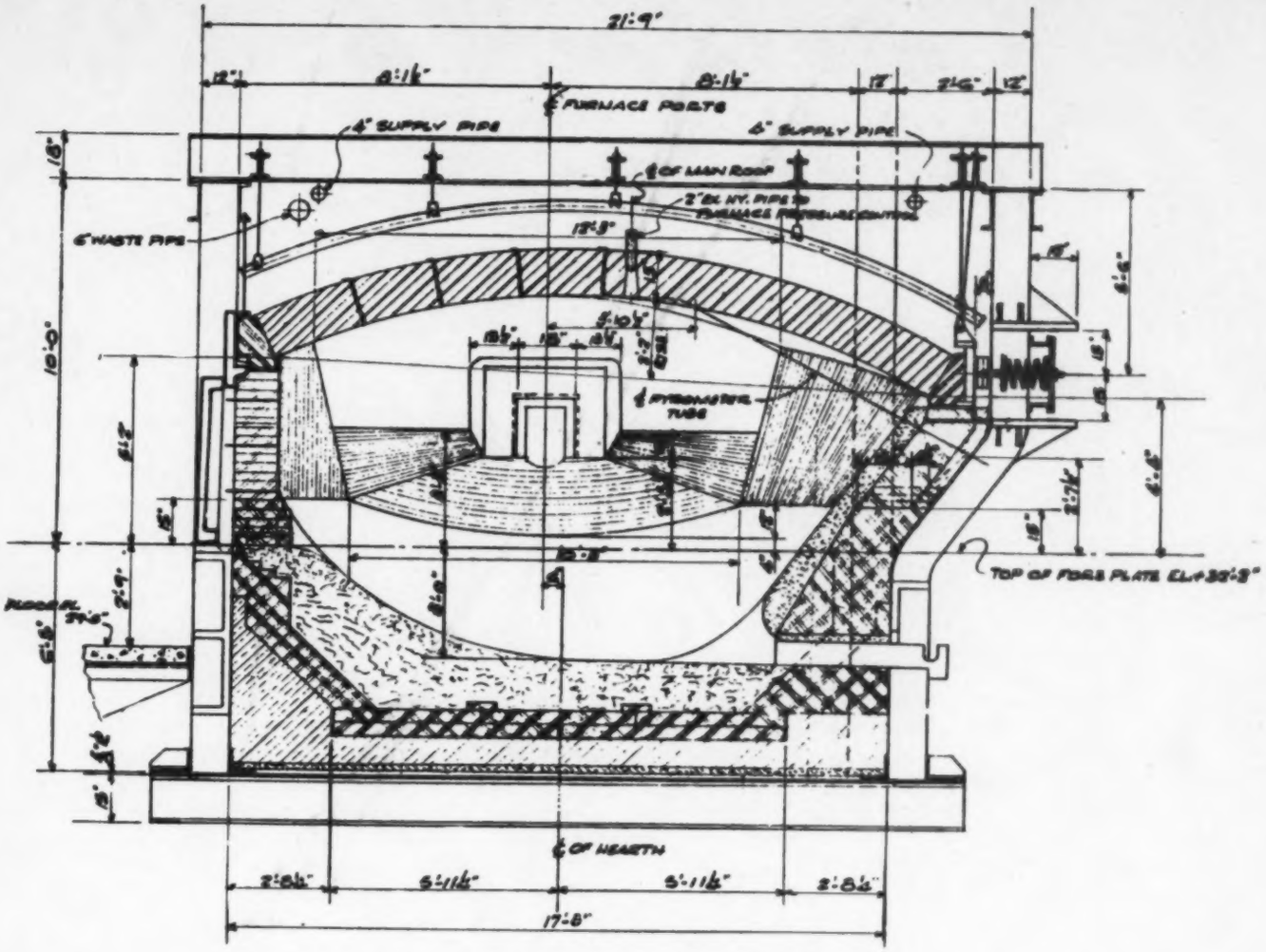
Each checker chamber contains 5016 cubic feet of checker work, comprising 17,757 square feet of heating surface. This corresponds to 3.54 square feet of heating surface per cubic feet of checker volume, and 0.57 square feet of free area per square foot of horizontal checker area. Provision is made for blowing the checkers and flues periodically with steam.

Fantails — The fantails are the passageways connecting the slag pockets with the checker chambers at each end of the furnace. The fantail walls are built of the same basic refractories as the corresponding port and slag pocket walls. The slag pocket bridge wall is air cooled, has a slope of about 45 degrees, and is constructed of a 9 in. course of plain chrome-magnesite brick above a 9 in. course of first quality firebrick laid over 2½ in. of insulating brick.

The fantail roofs consist of double-burned super duty firebrick, and are sealed with ½ in. of insulating concrete. These roofs are 12 in. thick, and of suspended construction using refractory hangers.

Flues — The flue system remains the same as for the original furnace. This consists of a double set of flues leading from each checker chamber to the stack flue. The original reversing valves, consisting of a butterfly air valve (set in stack flue) and a dyblic gas valve, are used. During the rebuilding the butterfly air valve was replaced with one made of heat resisting alloy.

There is a waste heat boiler in the system. Waste heat to an air preheater is taken from the flue just before



Vertical cross section through centerline of furnace.

the waste heat boiler. The preheater, for preheating the air used to atomize the oil, is made of alloy steel tubes. An induced draft fan and air compressor are used in connection with the air preheater.

Control devices — The original furnace had devices for measuring the quantity and pressure of fuel oil, the pressure of steam for fuel atomization, the furnace pressure, the stack draft, and the temperatures of the inside face of the main roof, of the checker chambers, and of the gases entering and leaving the waste heat boiler. The temperature of the inside face of the main roof was taken with a radiation tube located in the furnace back wall. The checker chamber temperatures were taken with thermocouples located in the bulkhead ends of the chambers, above the checkers.

When the furnace was rebuilt with a basic lining, devices were added for measuring the temperature of the fuel oil and the heated atomizing air, the flow of atomizing air and steam, the flow of oxygen, for analyzing the waste gases, for measuring steam production, and for taking additional roof and checker temperature readings. The additional roof temperature readings will be taken by a radiation tube through the front wall, and by thermocouples located in the outside face of the roof tiles. The additional checker temperatures will be taken by a radiation tube in each chamber located in the inside checker wall, and sighted upon the roof over the checker bridge wall.

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CLEVELAND PUBLIC AUDITORIUM

CLEVELAND, OHIO

SEPTEMBER 28, 29, 30 AND OCTOBER 1, 1948

Welding Applications in Ore Bridges

. . . . for the first time, an ore bridge has been built with all components welded except the main truss and cantilever spans . . . .

By GEORGE F. WOLFE
Welding Consultant
Dravo Corporation
Pittsburgh, Pennsylvania

▲ A 15-ton capacity ore bridge, in which welding was used for the first time on several main components, was recently completed for a major steel company. Another feature of design is the use of low alloy steel in the trolley and substantial reduction of the dead weight of this unit. Several mechanical innovations were also incorporated in the design of the trolley.

Except for the main truss span and the cantilever spans, all parts of the bridge were assembled by welding. The introduction of welding in ore bridges gives greater rigidity in the joints and, dependent upon considerations of adequate structural rigidity, permits the use of somewhat lighter sections in the structure. Another advantage of welded construction is in reducing maintenance. Many bridges are located near sinter plants where abrasive and corrosive dust penetrates every crevice in a structure and hastens deterioration. Such conditions are expected to influence the demand for welded construction.

Further advances in welding material-handling bridges, particularly the welding of joints that are subjected most to fatigue stresses, require more research on full size joints like those to be used in actual construction practice. The main truss span might also have been of welded construction except that the only economical type of welded joint for this type of structure would have uncertain strength, based on current available information, when subjected to fatigue stresses. These fatigue stresses are produced by movements of the trolley which cause frequent reversals of stresses in certain parts of the structure.

The welded ore bridge is of the skew type, which permits either leg of the bridge, when traveling, to advance beyond the other about 21½ ft or until a

Figure 1 — In all but the superstructure, welded construction is used in this new ore bridge.

5-degree skew is reached. Cantilever spans in the superstructure are 158½ ft and 169½ ft long. The two supporting legs each have 32 rolled steel wheels of 27 in. diameter, which are fully equalized for carrying the 1250-ton bridge on tracks of 4 ft 8½ in. gage. Each set of 16 bridge travel wheels is worm gear driven by a single 65-hp motor. Bridge travel speed is 100 fpm.

Both legs were shop-assembled to assure proper fit of these complex welded structures, thus avoiding delays in final erection. Shipping units were made as large as possible to minimize field welding. The shear leg, which is the simpler of the two, forms an archway with a supporting bronze bushed ball and socket joint over the top center, from which the superstructure is hung. This construction permits the shear leg to lean toward the center span as the bridge skews, and during this period the structure is stabilized by the pier leg.

The pier leg is a double V-shaped structure supported by a trussed sill on the trucks and carrying two box girders at the top for the sliding support of the superstructure. Except for the two box girders of plate construction, the pier leg was made entirely of beams, channels and angles. To provide for smooth skewing action there are four supporting skew plates in a true plane where the trusses of the superstructure rest on the pier leg, with a centering pin at the center of rotation. The use of welding on this leg permitted great simplification of detail, which was especially beneficial at the points where the legs meet the box girders.

The pier leg was erected first, and required a minimum of falsework. All joints were brought into the same relative position that they had had during shop assembly, and when the top girders were placed, no vertical adjustment was needed to put the four corners in a plane.

As soon as the main joints of the pier leg were welded, the erection of the superstructure was started with the center span carried on two falsework bents which were moved progressively toward the shear leg. Cantilever spans were erected without falsework.

The 120-ton, all-welded trolley is supported on four 33-in. diameter spring-mounted wheels. Two 75-hp motors drive the trolley through herringbone gear reductions at speeds up to 900 fpm. This makes possible a duty cycle of approximately one minute, which enables a good trolley operator to handle 900 tons of ore per hour.

The main framework on the trolley is an 8½-ton weldment 10¾ ft wide and 33½ ft long, made of low-alloy steel. The control house was shop welded into large assemblies and the operator's cab made as a complete unit with all control equipment. Additional saving of weight was achieved by using low-alloy steel for the floor plates and most of the siding in the trolley control house and cab. A few steel castings were also used in building up the trolley weldment, dictated by economy and structural considerations.

There was a departure from the conventional arrangement of hoist drums for the Hoover-Mason type bucket. Each of the four drums is individually worm driven and the drums located to suit the rope pattern of the bucket. The two opening drums and the two closing drums are flexibly connected in pairs to assure equal rope take-up during hoisting. An important advantage of the new arrangement is that all parts are accessible for maintenance and repair.

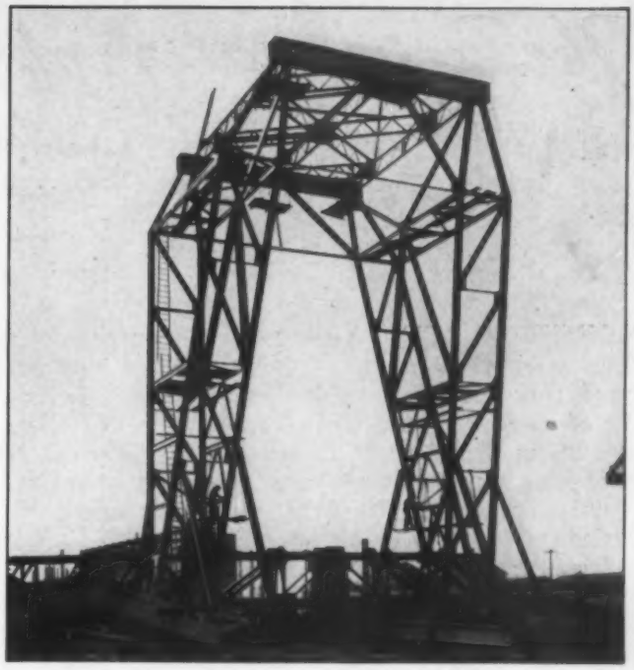


Figure 2 — The all-welded pier leg of the new ore bridge was erected with a minimum of falsework.

The drum assembly, a convenient unit for shop repair, can be removed by detaching two bearing caps, oil lines and one pin. Each worm has its own circulating oil system, assuring positive lubrication. Oil temperature, which is indicated in the operator's cab, is kept down by a "hairpin" cooler.

Hydraulic buffers were provided at each end of the trolley runway to completely and safely decelerate the loaded trolley from full speed in an emergency. In testing this modern structure the loaded trolley was run into these buffers at full speed without injuring either the operator or the structure.

It is anticipated that the successful completion and resulting performance of this first ore bridge having major welded components will point the way toward the further application of welding in this class of structure.

Figure 3 — The shop preassembly of the ore bridge truck equalizer system shows clean-cut construction made possible by welding.

The Depreciation of Industrial Facilities

By CHARLES R. COX

President

Carnegie-Illinois Steel Corporation

Pittsburgh, Pennsylvania

▲ DEPRECIATION is a general term signifying loss of value with the passage of time. Valuation may be stated according to the original cost of a facility, the cost of its replacement, the price for which it can be sold, the amount of profit it earns, and by many other standards. Depreciation of these values is computed by formulas such as sinking fund, completed periods of service, unit production, and others.

The particular variety of depreciation with which American industry is chiefly concerned is that recognized by the Bureau of Internal Revenue as an operating expense for which a deduction from taxable income is permissive. Only by accident does it bear any direct relation to loss of earning capacity, replacement cost, or market value of the facilities involved. It is merely a method for charging to operating expenses, over a period of years, the original cost in dollars of a capital item, regardless of the variation in the value of the dollar during the life of the facility.

The charge to operations thus made is expressed in the monetary unit current in each year. This would be satisfactory if the units so charged represented a stable measure of values. Unfortunately this is not the case; the value of our monetary unit, the United States dollar, is subject to radical disturbance with the passage of time due to changes in the economic picture. It follows that while the total or charges to operations may equal the original dollar cost of a certain facility, the value represented by the dollars so charged may, and usually does, fall far short of the original value of the facility. This discrepancy is usually greater in the case of long-lived than of short-lived facilities because of the greater lapse of time between the original expenditure and the charging of that expenditure to operations.

Money is valuable in providing a generally accepted medium for the exchange of diversified products at a given time; it is far from a perfect medium for the comparison of values at different times. There is no imaginable unit which can be depended on to maintain an invariable value with the passage of time. Even the gold dollar as established prior to the year 1933 and defined in precise terms of weight and fineness, represented the sum of all human effort required to recover a definite weight of the precious metal from the surface of the earth. Its real value was subject to change with the productivity of mining operations and its commercial value fluctuated with the varying demands of business for a standard medium.

In 1933 the gold content of the dollar was nominally reduced by 41 per cent, but this had little actual significance as affecting the purchasing power because the possession of any gold coin was made illegal and our medium of exchange became paper, not convertible to gold, but dependent for its value on governmental fiat and on the degree of public confidence in the integrity of executive manipulation.

The chief reason for this state of affairs is found in the fact that devaluation of the currency is a device for the repudiation of debt. Although many bonds, public and private, were specifically payable in United States gold coin of the present standard of weight and fineness, the court held in a majority decision that such obligations should be payable only in the depreciated dollars.

This experience points the moral that the best way to avoid insolvency is to pay current debts with current money. The repudiation of long-term debt by one means or another is not the exception but the rule. While this process is painful, it is so nearly inevitable that all any of us can hope for is to minimize our participation in the loss. A brief consideration of capital expenditures and capital obligations will make this clear. Real capital is the production by one generation above its current consumption, passed on to succeeding generations for useful employment. Capital obligations are promises to pay, made by the recipients of the capital assets when provided, in the hope that the later generations which derive the benefits will redeem the promises.

The evidences of debt in actual experience are continually outrunning the value of the assets. This is the way of the world. Usable investment is limited by the

Charles R. Cox is shown, left, greeting L. R. Milburn, president of the Association of Iron and Steel Engineers.

Presented before the AISE Annual Convention Banquet, Pittsburgh, Pennsylvania, September 24, 1947.

law of diminishing returns; each investment narrows the field in which future investments may profitably be applied. Capital obligations, on the other hand, grow like snowballs. They become loaded with items which the successors of the borrowers are unable or unwilling to assume. The people who are required to meet the obligations are subject to the very human tendency to rebel against constraint by dead hands and to seek relief by any expedient that will cut down the load of debt. The four freedoms are really five and the one implicit in most of the so-called "liberal" policies is — freedom from debt.

As the useful investments are therefore curtailed by limited opportunity, the promises to pay increase according to the table of compound interest. When the two divergent trends are forcibly reconciled, some of the holders of the paper promises are certain to suffer loss.

Devaluation of our dollar is the chief factor in the rise of prices — but not the only one. Other factors are: the fluidity of credit promoted by the Federal Reserve System; the arbitrary cuts in production and heavy drain on our natural resources; the granting of subsidies to agriculture and other enterprises; and especially the sellers' market created by the war.

Of course there will be adjustments in some of these factors as time goes by, and future purchasing power of the dollar will be subject to both plus and minus influences. But even though the net effect cannot be foretold, continued long-term increase in costs and prices is apparent.

Between the years 1901 and 1946 dollar costs of steel plant construction rose in the ratio of five to one. The 1946 costs were about four times those of 1915 — double those of the average costs between 1919 and 1932, and 100 per cent higher than in 1939.

Heavy industries such as steel suffer most severely the penalties for inadequate reserves to meet advancing dollar prices. Most of steel's capital investment is in long-lived facilities, in contrast to industries whose facilities are quickly expendable and therefore chargeable to current operating costs or to capital investment depreciable over short periods. The latter class of industries includes motion picture production, trucking and taxicab service, and many others subject to sudden change in customer requirements or rapid technological advances.

This continuing change in the value of the dollar, coupled with the legal fiction that there is no such change, places productive enterprise in an awkward position. The federal tax nominally imposed only on income becomes in effect an actual assessment levied on capital investment. This levy, entirely beyond the original intent of the law, comes about through the failure to provide adequate reserves for the depreciation of capital assets.

I might mention that this changing value of the dollar is of importance not only to those planning major capital investments but also to every housewife who attempts to follow a budget and provide a replacement for Junior's trousers and sister's evening gown.

The Bureau of Internal Revenue has recognized no material change in its concept of depreciation in the thirty-four years since the beginning of constitutional taxation of income by the United States Government. But conditions have changed radically. The year 1913 followed a long period of relatively stable prices. Within a few years, however, the Federal Reserve System was established, World War I was fought, and the upward trend of prices and the corresponding downward trend in the value of the currency here definitely established. This had the effect of changing the tax on income to a levy on capital, disguised though it might be.

The reality of this disguised capital levy is worthy of careful consideration in planning long-term capital investments. We must not forget that actual net benefits will be the remainder after the deduction not only of present taxes but also of future concealed taxes which may be imposed by further devaluation of the currency.

The very purpose of the income tax has been distorted — it has been wielded to effect the social objectives of those in power. Originally simply a means of providing revenue for the services of government, it has been used to redistribute wealth through its steeply graduated rates for the several income brackets and the double taxation of corporate dividends. During the war the tax was openly and authoritatively described as a means of draining off surplus income to avert monetary inflation; in other words, to attain high production by paying workers increased dollars and then snatch the dollars away before they could be spent.

This resembles the scheme to speed up the old horse by dangling a wisp of oats just beyond his nose. The horse was too smart to fall for it, but I fear that the people of America have not been so smart.

Opposed to the stand taken by the Bureau of Internal Revenue on depreciation rates are early views expressed by the Supreme Court in decisions concerning public utility rates and corporation excise taxes. In a definition handed down nearly forty years ago the court evaluated depreciation in terms of *replacement* costs, although at that time there was no urgent reason for distinguishing between cost and value, as the currency was still redeemable in gold coin and prices were stable.

However, later decisions expressed a different view. In 1927 the court ruled that permissible depreciation should be limited to the cost of the part "used up," even though at the time it went out of operation its actual value and market price — that is, its replacement cost — may have been much higher. Thus, ironically, in a time of stable prices the court set up replacement cost as the measure of depreciation, while later, after a considerable rise in prices, it clearly rejected "replacement cost" in favor of "original cost."

The regulations of the Bureau of Internal Revenue specifically base depreciation on original cost, agreeing with the highest court's "second thought."

Despite direction signs such as dollar devaluation, erection of the Federal Reserve System, existence of sellers' markets during and after both World Wars, and increase in wages accompanied by decrease in production, the courts and the government turned their backs and took the opposite course, basing depreciation rates on original cost rather than present value.

Some misunderstanding of the matter of depreciation

occasionally arises from a confusion of terms. Many people consider a depreciation reserve as a sum of money waiting to be spent; that is, an asset. In accounting terms, a depreciation reserve is the amount by which the current book value of a capital asset falls short of the original cost. It is an amount to be subtracted from the gross (original) value and is therefore a liability. That liability continues to accrue with the passage of time, and if not balanced by continued new investment would eventually extinguish the original value. Depreciation is therefore a real and inescapable element in the cost of production. If income is not sufficient to cover this cost, as well as labor, materials, taxes, and other essential requirements, then the enterprise is in process of liquidation. In contrast to this real depreciation which is a necessary cost of doing business, book depreciation is a convenient accounting tool for the presentation of certain arithmetical operations. It may or may not have a close relationship with real depreciation which is an evaluation of the depreciation in terms of current dollars. If we are to use this tool at all, let us do so with a clear understanding of its proper application and in a manner to present clearly all the facts.

According to methods of accounting based on the present federal income tax law, and in general use for computing the net worth of industrial corporations, the accrual of depreciation is understated.

Let us examine the effect of inadequate reserves for depreciation. To balance the statement of financial condition, an understatement of this liability means a corresponding overstatement of surplus. Similarly on the income statement, too little annual depreciation means the understatement of producing costs and the overstatement of profits. The first error deceives the investor as to the net worth of his property and may lead to the payment of dividends out of capital under the mistaken opinion that they have been earned. The second error deceives the operator as to his actual cost of production and may result in the sale of product at ruinously low prices under the delusion that the business is profitable. Under the present federal law, this fictitious profit is taxable in real money just as if it had actually been earned. Another penalty which follows such an exaggerated report of earnings is an erroneous public opinion that the business is highly profitable and that justifiable demands may be made for lower prices and higher wages.

The financial effect on an enterprise of the shrinking dollar is not always entirely unfavorable. For example, interest on bonds is paid in current dollars as a part of the cost of current operations, with no penalty for the unequal value of the dollars borrowed and repaid. Such incidental gains constitute offsets, usually minor, to the loss incurred through the provision of inadequate depreciation reserves in terms of depreciated dollars.

We hope that this threat to the sound financing of essential industries will gain recognition and that legislative relief will be provided before a national calamity overtakes us.

One reason for entertaining such a hope is that the present course of business development is contrary to long-range national interest. For example, we read in the newspapers that expansion of steel-making capacity is needed to support a normal national economy in time of peaceful prosperity, and to provide security in case of war. While some departments of government feel the existence of this need, those authorities which have to do with taxation are denying to the owners, proper means of maintaining the properties they already have. When the relation of cause to effect becomes sufficiently apparent, we may hope for some relief.

To illustrate this confusion of policy, let us consider the position of the responsible executive officer of a manufacturing corporation. Among other duties, he has the responsibility of recommending projects for capital expenditures, either for replacement of worn-out or obsolete facilities or for the expansion of production. He knows that even the maintenance of present position requires the continued investment of additional capital, as capital appears on the financial statement. Additional investment may be effected either with borrowed capital or by the re-investment of corporate profits. Knowing that the profits have been overstated and considering the many other demands on them, the executive is faced with the problem of deciding how far he should go with re-investment.

Most readers of the annual statement will assume that the profits therein, shown have actually been realized. Accordingly, the stockholders will expect dividends, customers will try to force price cuts, employees will demand higher wages and, most insistent of all, the tax collector will want his percentage. To yield to all these demands would mean the withholding of funds from the essential maintenance of productive facilities and would lead eventually to reduced capacity or to forced retirement from the business. Financing such maintenance with borrowed money would be unsound and would become increasingly difficult with the added debt.

To return to the specific problem of the steel industry; normal requirements for the replacement of worn-out or obsolete equipment must be met out of current receipts from customers before there can be any real return to the private owners of the business on their invested capital. The reporting of profits without explicit evaluation of depreciation in terms of current dollars may so far conceal the financial position of individual corporations as to mislead the stockholders and others in regard to the amount of actual additional capital being invested. It may even result in criticism of the management for applying some apparent earnings to investment in manufacturing plant instead of distributing them as dividends, thus permitting the stockholders to decide for themselves on the wisdom of reinvestment. The introduction of a sound method for the costing of depreciation would go far toward the presentation of a true picture of corporate income and condition. Among the other benefits already enumerated, such a picture would convey to the owners of the business a correct estimate of the earnings and a clear understanding of the disposition of those earnings by their directors and executive officers.

The present basic faults in the methods of evaluating corporate properties, assessing federal taxes and computing profits have been pointed out. Some of

the difficulties in the way of a general revision or reinterpretation of the present tax laws have also been presented. While the proposal of changes in the law is a matter for careful consideration by legal, financial, and public relations authorities, it does not appear that there is any immediate chance of enactment of any general law to afford adequate relief. This statement is based on several considerations. First the public, including stockholders and employees, is not yet fully aware of the devaluation of the dollar. It is well known that prices are high but not so well known that the reason is largely to be found in the lack of value in the medium of exchange. Next, the present extent of devaluation is not great enough to evoke a popular demand for the heroic measures that would be necessary to avert a national calamity. Most people still think of shortages of commodities as an evil to be combated by price adjustments. That is only part of the story: price adjustments that stimulate production will contribute to correction, but price adjustments on the basis of artificial scarcities merely hasten a general collapse. It is a basic fact that wealth must be produced before it can be distributed. Finally, in the case of corporation finance, there would be strong political opposition to any measure of relief which did not recognize and perhaps exaggerate the offsetting advantages enjoyed by the corporations as a result of the devaluation, as compared with the greater disadvantage of inadequate depreciation reserve.

For these main reasons and other minor ones, it appears idle to expect any broad relief from the present fallacious method of accounting for tax purposes. On the other hand, there may be a chance that minor changes in the laws might afford relief, such as reappraisal of certain property items under stated conditions or approval of the creation of additional reserves from earnings to provide for specific property replacements.

Pending the enactment of measures such as suggested, attention should be given to all accounting procedures designed to pay current costs in current dollars.

Up to this point we have been discussing the need for correct evaluation of the depreciation of physical assets. We have shown the evil effects of misleading statements, outlined some of the obstacles in the way of correct reporting, and have suggested measures for minimizing the damage suffered because of the resulting misunderstandings. We have shown that action taken on the basis of so-called orthodox instead of realistic accounting may result in misuse of corporation funds and may encourage fantastic hopes for dividends, wage increases, and price cuts. Let us now briefly refer to one problem in which depreciation records are frequently consulted but on which they have no proper bearing whatever. When the financial justification of the replacement of a certain machine or other facility comes up for investigation, the first question in many minds is, "Is it fully depreciated?" If the answer is "Yes," then it may be hastily assumed that replacement should follow as a matter of course, and if "No" that we are about to incur some loss by the proposed retirement. We are prone to the error of confusing book value with actual value, that is, earning capacity. If we are too quick to discard a revenue producing unit because it is fully paid for, while still capable of economical production, we fall into the very human, but very costly frame of mind which gives rise to the old proverb "Easy come, easy go." If on the other hand we refuse to discard a book asset which possesses no earning power, we are guilty of the equally unwise practice of "Throwing good money after bad."

In brief, this is what has occurred:

1. A law imposing taxes on income has been interpreted by the government agencies and courts to effect a levy on invested capital.
2. Collection of this tax has been camouflaged as a tax on profits which in fact do not exist.
3. The publication of these fictitious earnings as actual profit has led government, customers, employees, and stockholders to expect more from the steel business than there is in it.
4. In an effort to temporize with these varied demands, legitimate operating expenses have been accounted as the re-investment of profits, and these nonexistent profits have been made subject to federal income tax.
5. This re-investment is not calculated as a voluntary expenditure in the hope of future profit, but is forced on the owners of the properties to prevent the slow death of their plants due to the deficits in depreciation recoveries.
6. Despite a national need for steel in peace or war, the maintenance of even present productive capacity is endangered by oppressive restrictions on real earnings.
7. The evils of fictitious accounting flow chiefly from the debasement of the currency practiced as an expedient for the writing off or writing down of public and private debt.

As for corrective measures, we can suggest in broad outline the following:

1. Convey correct information on earnings and financial condition to all concerned as, for example, by including in the annual report an explicit evaluation of the depreciation of facilities in current dollars and the deficiency resulting from the expression of this depreciation in terms of original dollar cost. The effect of the deficiency should be carried through the statements of earnings and financial condition to make clear even to a casual reader the true earnings and actual additions to productive investment.
2. Work for a revision of law and regulations to tax only true earnings and not capital as income.

The insidious dissipation of capital because of tax rulings, which are insufficiently flexible to encompass changing economic conditions, is obvious.

The consequences reach far beyond the owners of the particular industries involved.

When industry fails to replace constantly its producing facilities with the fruits of technological advancement, which are cost reducing, quality improving devices, the entire economy suffers. Dwindling funds for replacement, are a consequence of faulty depreciation accounting.

The American economy is based on a constantly rising standard of living, in turn based on technological advancement. The act of limiting such technological advancement is a blow at the rising standard of living. Corrective action is imperative — and at once.

Get Double Protection Against Motor Burnouts from Overloads or Single Phasing—

By Installing

FUSETRONS

"In Seven Years We have Not Lost a Motor Due to Single Phasing When Protected with Fusetrons

"City water pumps are driven by four 20 h.p. three phase 440 volt 24 ampere motors. The motors are equipped with overload relays.

"In the first three years after these motors were installed in 1935, two were burned out from single phasing.

"Mr. S. O. Petterson, our City Water Works Electrician, in August, 1938, installed 30 ampere Fusetrons to protect these motors.

"On September 5, 1938, a severe electrical storm hit this area, causing many phase failures in power lines. Three of the four pump motors at Alderwood Station were operating at the time. Each single phased and each came off the line with no damage, other than the blowing of the Fusetrons. When the Fusetrons were replaced, everything worked perfectly as though there had been no storm. In the seven years since then we have not lost a single one of these motors.

"The next day after the storm, I said to Mr. Petterson, 'Those gadgets you call Fusetrons are certainly the finest protection ever devised for motors. They saved us over $300.00 last night!' "

Herbert J. Carson
Asst. Supt. Water Department
City of Everett, Washington

Here's Proof from a Fusetron User—

BUSS

At Little or No Extra Cost — Fusetrons Provide *Extra Safety* for Motors

IT'S TRUE that most large motors are protected with thermal cutouts or overload relays—BUT experience shows that such mechanical devices sometimes fail to operate, and you may burn out a motor.

At little or *no extra cost* Fusetrons, on normal installations, eliminate this danger by giving your motors DOUBLE PROTECTION against burnout from single phasing or any dangerous overload. You simply replace fuses used for short-circuit protection with Fusetrons of motor-running protection size. Then, you get short-circuit protection plus motor-running protection.

Why Fusetrons Give Motor-Burnout Protection

Fusetrons have a tremendous time-lag which ordinary fuses and circuit breakers do not have. This means that Fusetrons can be used in a size close to the actual running current of the motor, while ordinary fuses and circuit breakers must be installed oversize to hold the motor starting current.

Therefore, ordinary fuses or circuit breakers can give only short-circuit protection. They cannot protect either the motor or the starter against burnout.

But, on normal installations, when Fusetrons of proper size are used, any current dangerously in excess of normal motor running current will cause them to open. Thus, they protect should other overload devices fail — they give the motor *double protection* against burnout.

Provide the Simplest Way To Prevent Damage from Single Phasing.

When single phasing occurs, the current flowing through the motor, and through the Fusetron, in the remaining phase increases nearly 100%. This 100% overload will open a Fusetron of motor-running protection size and stop the flow of current before the motor can be damaged.

WHY THIS EXTRA SAFETY FOR YOUR MOTORS COSTS YOU LITTLE OR NOTHING

Large size fuses are replaced with SMALLER size Fusetrons. This means a step down in the price range.

For example: The lowest cost 100 amp. 250 volt fuse costs approximately $0.40. A 60 amp. Fusetron to replace it costs about $0.36 — (BUSS Fuse Reducers to make the change possible cost but little and need never be replaced.)

That is why you need not worry about the cost of replacing fuses with Fusetrons even though installing Fusetrons means that you REDUCE MANY, MANY TIMES THE CHANCE OF HAVING A MOTOR BURN OUT.

On new installations you ACTUALLY SAVE MONEY because proper size switches or panels are installed, instead of oversize equipment needed to take fuses large enough to hold motor starting current. The smaller size Fusetrons further reduce costs.

What is the FUSETRON?

- The Fusetron is a DUAL element device — A Fuse to which is added a Thermal Cutout.
- The result is a fuse with tremendous time-lag and much less electrical resistance.
- Fusetrons have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.
- Fusetrons are made to same dimensions as ordinary fuses and fit all standard fuse holders.
- They are obtainable in all sizes from 1/10 to 600 ampere — in both 250 and 600 volt types.
- Also obtainable in plug type and tamper-resisting type (Fustats) for 125 volt circuits.
- Their cost is surprisingly low.

Fusetrons Provide Many Kinds of Protection Not Provided by Ordinary Protective Devices — if Installed throughout the Electrical System.

★ Entirely wipe out needless blows caused by motor starting currents or other harmless overloads. ★ Give Thermal Protection to Panelboards and Switches. ★ Prevent Needless Blows caused by Heating in Panels and Switches. ★ Permit use of larger motor or adding more motors on circuit WITHOUT installing larger switch or panel. ★ On new installations, PROPER size switches and panels can be used instead of OVERSIZE. ★ Protect motors against burnout. ★ Give DOUBLE protection to large motors. ★ Provide simplest way to stop burnouts from single phasing. ★ Make burnout protection of SMALL motors simple and inexpensive. ★ Protect coils, Transformers and Solenoids against burnout.

Get All The Facts . . .

Get Better Protection — Send the Coupon Now

Even one lost motor or one needless shutdown or one destroyed panel may cost you more than replacing every fuse with a Fusetron. Don't risk such losses. Change over the whole plant to Fusetrons.

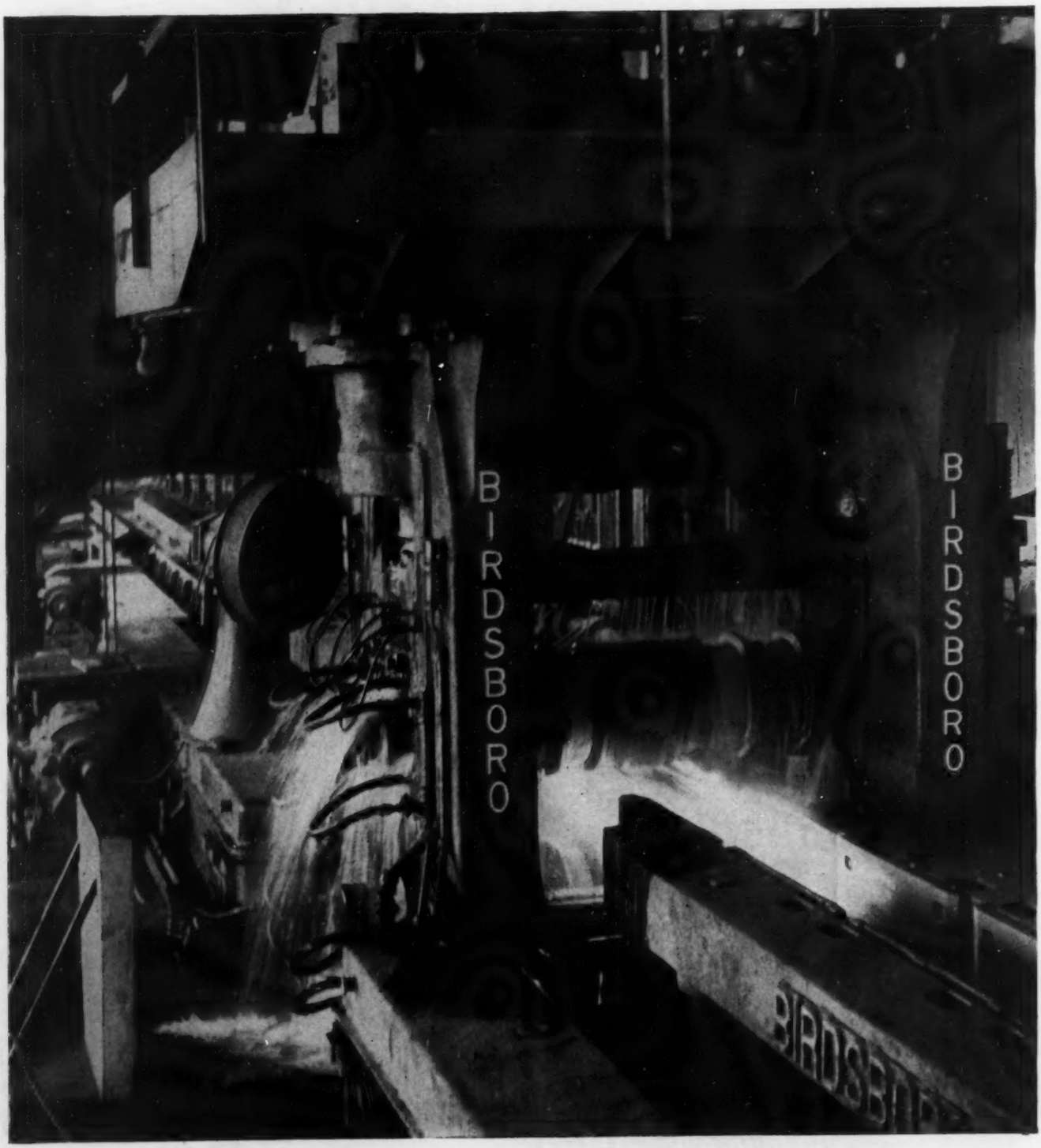
Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)
Please send me complete facts about BUSS Fusetrons.

Name_____
Title_____
Company_____
Address_____
City_____ State_____

FUSETRONS

SOLD THROUGH WHOLESALERS

SPEED UP Mass Production

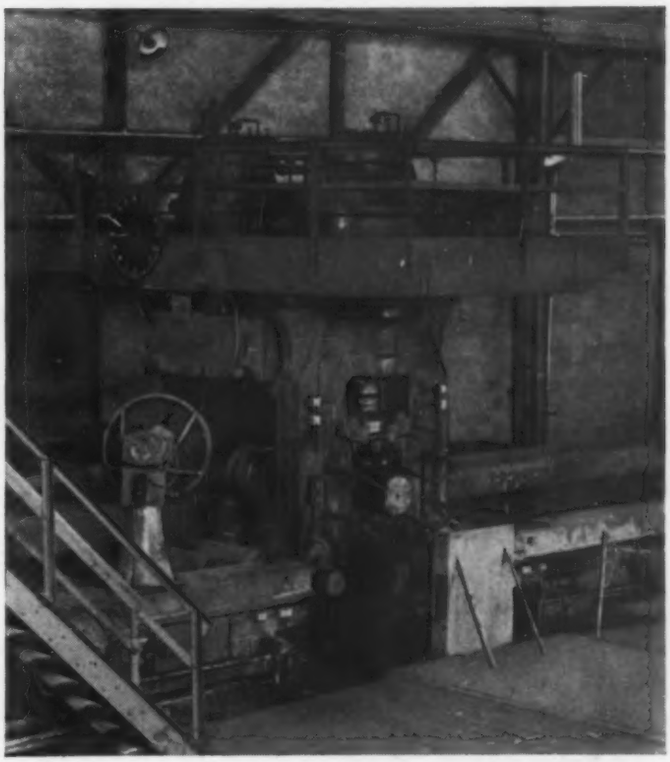


# of Steel with BIRDSBORO BLOOMING MILLS

PROBLEM ➡ Mass production of high quality stainless, high speed, automobile and special purpose alloy steels with minimum labor costs.

SOLUTION

This 2-high, rapid reversing 26-in. blooming mill with fast screw-down and rapid manipulation, operated by two men.



Birdsboro's engineering facilities make possible the design and construction of "custom-built" blooming mills which, today, are helping many manufacturers catch up with the demand for all types of durable goods.

Let our engineers go to work with yours in the planning stage and in this way, come up with a practical solution that will speed production as well as hold down operating and maintenance costs.

BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY • BIRDSBORO, PA.

BUILDERS OF: Steel Mill Equipment • Rolls • Hydraulic Presses • Special Machinery • Crushing Machinery • Steel Castings

BES 2-47

BIRDSBORO

STEEL MILL EQUIPMENT

Only in a PENNSYLVANIA TRANSFORMER do you get the Straight Line Tap Changer with Silver Alloy Contacts

All you want in a Tap Changer and More!

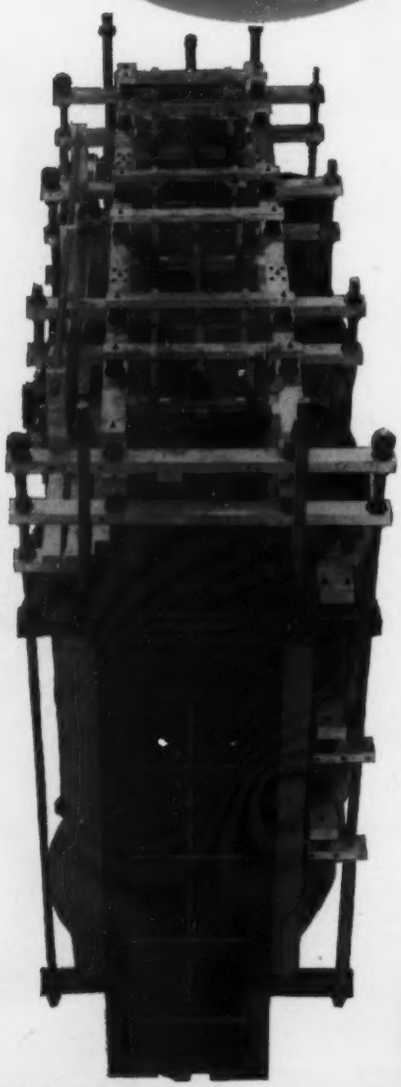
SILVER ALLOY CONTACTS

SELF-ALIGNING CONTACTS

SIMPLE IN DESIGN

RELIABLE IN CONSTRUCTION

WILL NOT FREEZE IN POSITION



20,000 Kva, 3 Phase, 25 Cycles, OISC, 44000-6600 volts.

Arrangement of tap changers on 3 phase, transformer. Note that all 6 tap changers are operated by a single shaft.

Gives Pennsylvania Power Transformers Unsurpassed Reliability . .

★ ***NO HOT SPOTS***

Silver alloy contacts are capable of carrying heavy overloads and withstanding short circuits without overheating because of low initial contact resistance.

★ ***DURABLE***

Hardness of silver contacts prevents harmful wear, even under continuous operation such as in a motor-operated tap changer. Contacts are installed with a minimum of flat surface at the contact points to prevent the accumulation of sludge. Silver alloy contacts will never freeze in position.

★ ***EASY TO OPERATE***

The direct connection of the shaft to the gear and use of a minimum number of bearings, plus the application of low friction, silver alloy contacts, result in a very low torque and an easy to operate tap changer.

★ ***SELF-ALIGNING***

Pennsylvania Tap Changers possess a self-aligning feature which assures a high pressure contact at all times. This is accomplished by the special steel spring construction and straight-line motion of the movable jaw.

★ ***CORONA ELIMINATED***

In higher voltage tap changers the elimination of corona is very important. This is accomplished in Pennsylvania Tap Changers by electro-static shields of spun copper connected to the live parts of the tap changer. Discharges due to corona are thus prevented.

Pennsylvania TRANSFORMERS

Pennsylvania

TRANSFORMER COMPANY

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Avoid these costly shutdowns

INSTALL NOW

For next winter's critical time

NORTH AMERICAN
DUAL-FUEL BURNING SYSTEMS
FOR GAS AND OIL

- Switch fuel without any piping changes.
- Automatic fuel-air ratio control.
- Maximum efficiency either oil or gas.
- There is a North American Factory-Trained Engineer in your district.

THE NORTH AMERICAN MANUFACTURING COMPANY
CLEVELAND 5, OHIO

Delivers Up to 4700 CFM at pressures to 1½ lbs.!

A self-contained, compact unit! Photo shows direct connected subbase construction of "Buffalo" CB Pressure Blower. Rotor is overhung on extended motor shaft.

IF YOU NEED LOW COST, DEPENDABLE PRESSURE BLOWING, WRITE US NOW FOR BULLETIN 3553

That's one good reason

"Buffalo" CB Pressure Blowers give you unequalled service in:

- Handling air for oil or gas furnaces
- Gas exhausting and line boosting
- High pressure installation in steel, glass and chemical plants

— and many other services where high pressures are required, with low to moderate volumes.

EFFICIENCY - WEARABILITY

ACCESSIBILITY

At left, you see the narrow, extremely rigid construction of "Buffalo" CB Pressure Blowers. Rotors are dynamically balanced at the factory, and tested in the "Buffalo" Vacuum Pit at tip speeds far in excess of operating speeds to be encountered. Hub is turned out of steel stock. Housing is heavy welded plate, ribbed for strength and surprisingly light over-all weight.

BUFFALO FORGE CO.

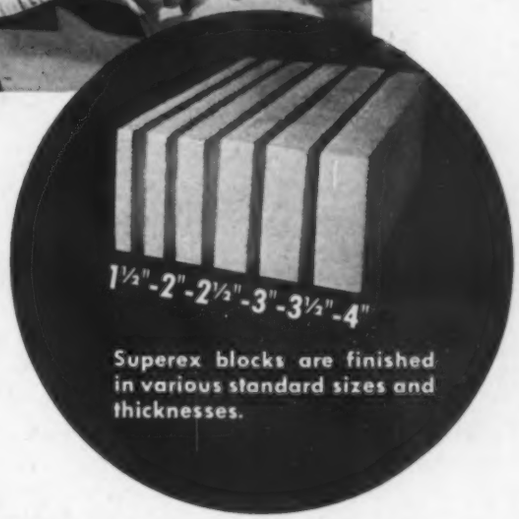
173 Mortimer Street Buffalo, N. Y.
Canadian Blower & Forge Company, Ltd.
Kitchener, Ont.

"Buffalo"

TYPE C B PRESSURE BLOWERS

"What block insulation shall we use?"

"SUPEREX, it's been our standard for over 20 Years"



Superex blocks are finished in various standard sizes and thicknesses.

• For temperatures to 1900 F, Superex is used more than any other block insulation behind refractory linings of hot blast stoves, mains, bustle pipes, kilns, regenerators, roasters, flues, stacks, industrial and metallurgical furnaces, stationary and marine boilers and auxiliary power plant equipment.

These seven outstanding advantages have made Superex the leading block insulation:

1. Low Thermal Conductivity—Superex is made from specially selected calcined diatomaceous silica, bonded with asbestos fibre—presenting a formidable barrier to the passage of heat.

2. High Heat Resistance—J-M Superex Blocks safely withstand temperatures up to 1900 F without deterioration.

3. Light Weight—Approximately 24 lbs. per cu. ft.

4. High Physical Strength—Withstands vibration and other physical abuse encountered in normal service. Approximately five tons pressure per square foot are required to compress Superex ⅛ inch.

5. Permanent Efficiency—Superex maintains high thermal efficiency indefinitely—will not disintegrate in service for which recommended.

6. Quick Application—The convenient sizes and light weight of Superex assure fast, economical installations.

7. Easy Cutting and Fitting—Superex is easily cut with an ordinary knife or saw for fitting around openings or irregular surfaces.

Special shapes or curved blocks—in addition to the 6 standard thicknesses illustrated—can be supplied. Write Johns-Manville, Box 290, New York 16, N. Y.

JOHNS-MANVILLE *First in* INSULATIONS

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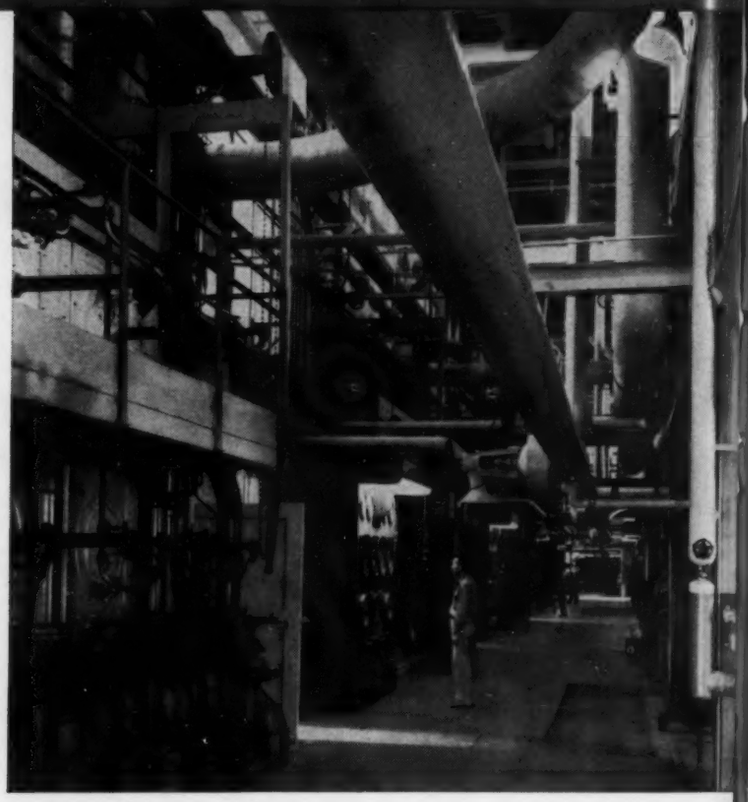

How much POWER

—can Dowell chemical cleaning restore for you?

Figure it in dollars and cents: How much power are you losing due to accumulations of scale and sludge in boilers, condensers and other heat-exchange equipment? How much is it costing you for the extra fuel required to overcome the reduced efficiency imposed on your plant by *insulating deposits?*

Take a good look at your designed operating efficiency—and compare it with the *actual output* you are securing. Then call the nearest Dowell office for the facts and figures on *chemical* scale removal service.

Leading plants everywhere rely upon Dowell service—including some of the largest boiler installations in the nation. They tried Dowell service and found it rapid, safe and economical. They've seen Dowell engineers fill plant equipment with liquid solvents designed to dissolve and disintegrate scale and sludge—and they've seen the *results.* You'll make no mistake to follow their example—get the facts.

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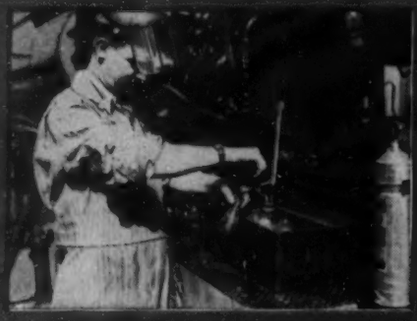
New York, Boston, Philadelphia, Wilmington, Baltimore, Pittsburgh, Buffalo, Cleveland, Cincinnati, Detroit, Chicago, St. Louis, Kansas City, Wichita, Oklahoma City, Houston, Fort Worth, Shreveport, Mt. Pleasant, Michigan; Salem, Ill.; Borger, Texas; Wichita Falls, Texas; Midland, Texas; Lafayette, La.

Long Beach, Casper: Dowell Associate—International Cementers, Inc.



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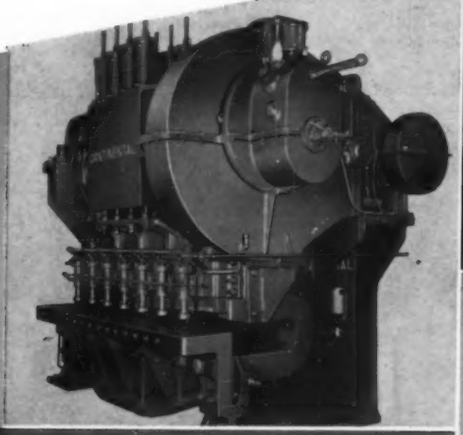
FOR INDUSTRIAL CHEMICAL SERVICE

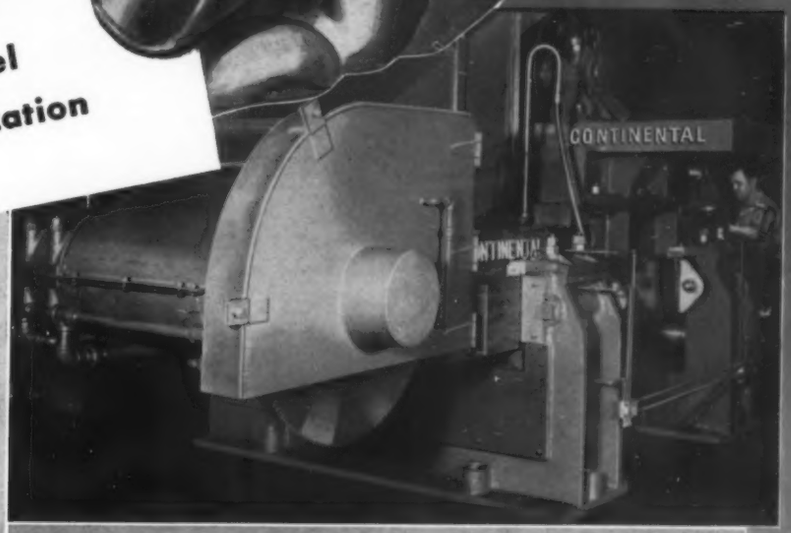
Dowell service is supervised by trained engineers using carefully selected liquid solvents and special mobile equipment.

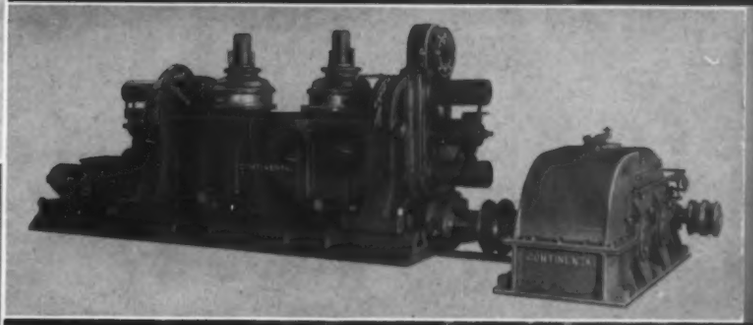
a Specialty!

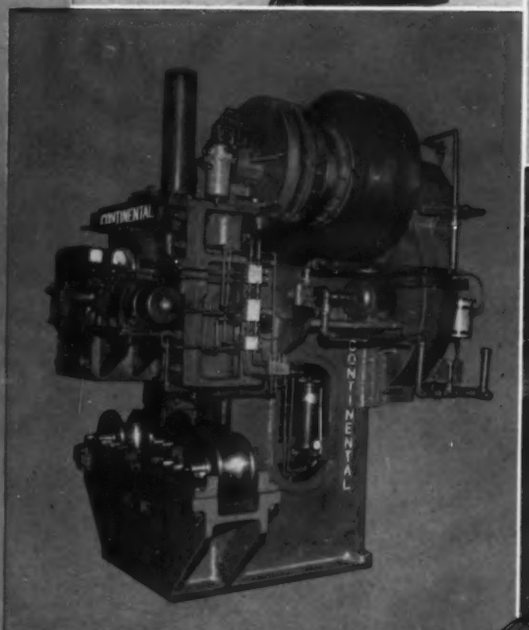
STEEL PLANT EQUIPMENT

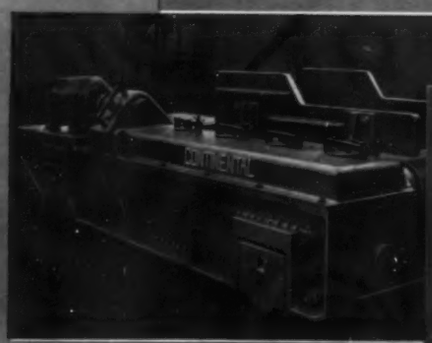
Custom Engineered for Steel Plant Expansion and Modernization











Continental

Continental FOUNDRY & MACHINE CO.

CHICAGO • PITTSBURGH

Plants at East Chicago, Ind. • Wheeling, W. Va. • Pittsburgh, Pa.

Industry's Headquarters for Carbon and Alloy Steel Castings Rolling Mills and Equipment Iron and Steel Rolls

TOP OR BOTTOM
RIGHT OR LEFT
UP OR DOWN

DE LAVAL SPEED REDUCERS

If it's a right angle drive you need, with high speed shaft either above or below the output shaft, with either shaft extended to right or left, or with the output shaft either horizontal or vertical—there's a De Laval Worm Gear Speed Reducer designed to meet the requirements. Ask a De Laval representative to show you the wide choice available.

✳ This single reduction De Laval Worm Gear Speed Reducer is available in many standard gear ratios and is but one of 93 sizes of standard De Laval Worm Gear Speed Reducers.

✳ ONE OF 93

WG-15

WORM GEAR DIVISION

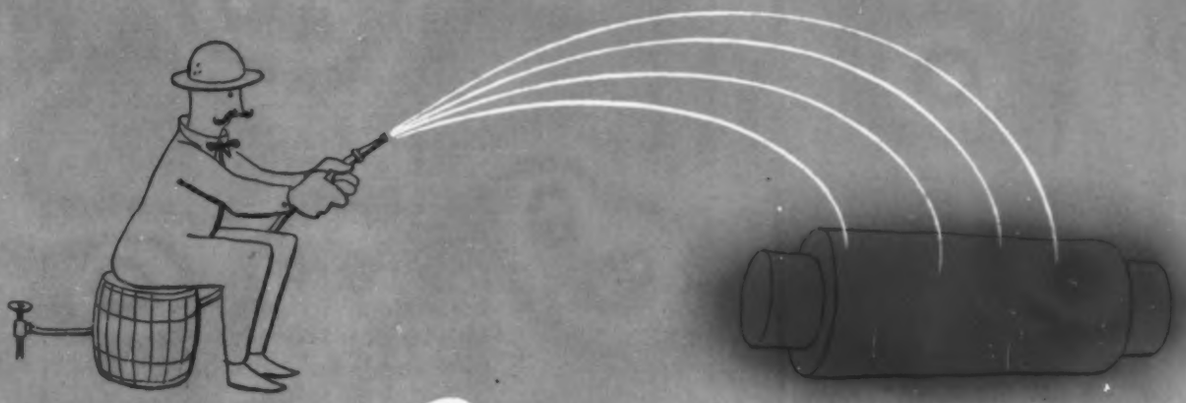
DE LAVAL

STEAM TURBINE COMPANY
TRENTON 2, NEW JERSEY

Atlanta • Boston • Charlotte • Chicago • Cleveland • Denver
Detroit • Edmonton • Helena • Houston • Kansas City • Los
Angeles • New Orleans • New York • Philadelphia • Pittsburgh
Rochester • St. Paul • Salt Lake City • San Francisco • Seattle
Toronto • Tulsa • Vancouver • Washington, D.C. • Winnipeg

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

1913 *we developed the first water-cooled process for solidifying heavy bodies of rolls*



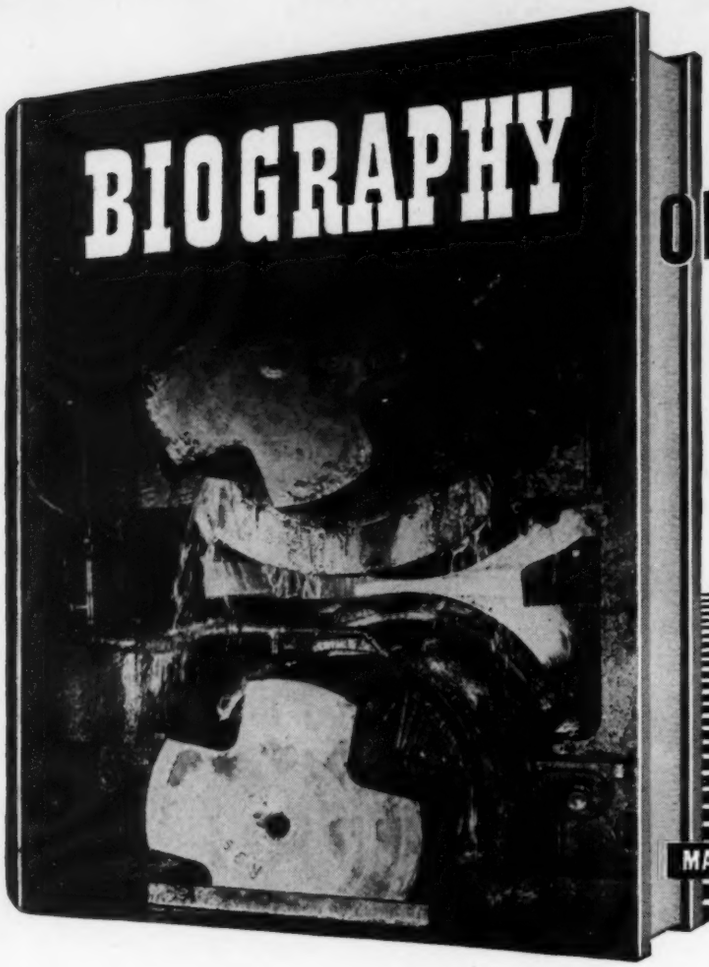
So what? In the development of Red Wabbler Rolls many special processes have been pioneered, improved, perfected—and then replaced as the need arose for better mill rolls, and better roll manufacturing methods. But these continuing developments were only possible because of your cooperation as experienced mill operators. Your own demands for greater rolling-mill production, better surface finishes, longer roll life, have been fulfilled by Red Wabbler Rolls because your training has supplied the practical metal-rolling know-how on which Mackintosh-Hemphill engineers and metallurgists base their research. In 1913, or 1923, or 1947—in any year and in every year—the success of metal-rolling operations depends on the skill of the operator and the knowledge and facilities of the roll manufacturer. In the combination of your own rolling-mill experience and Mackintosh-Hemphill roll engineering and manufacturing facilities there's a real productioneering team.

MACKINTOSH-HEMPHILL CO.

PITTSBURGH and MIDLAND, PA.

Makers of the rolls with the red wabblers

BIOGRAPHY OF AN N·B·M #200 BRONZE BEARING



MARCH, 1946:

On a prominent 44" Blooming Mill which averaged 85,000 tons on either babbitt or fabric, this bearing was put in trial service on the drive side, paired with a babbitted steel shell on tbe loose side.

AUGUST, 1946:

The bearing was pulled out for inspection. Despite this handicap of uneven wear, it had rolled 250,000 tons with only 5/16" wear.

FEBRUARY, 1947:

Tonnage now 350,000; some machine work done on bearing.

APRIL, 1947:

This N-B-M #200 Bronze Bearing had rolled almost 500,000 tons — still going strong!

It pays to switch to N-B-M Bearings. May we show you more detailed case histories?

N·B·M BRONZE AND COPPER CASTINGS

BLAST FURNACE COPPER CASTINGS • ROLL NECK BEARINGS • SLIPPERS HOUSING NUTS • MACHINERY CASTINGS • BABBITT METALS • ACID RESISTING CASTINGS • PHOSPHORIZED COPPER

NBM

AMERICAN Brake Shoe COMPANY

NATIONAL BEARING DIVISION
PITTSBURGH • NEW YORK

PLANTS IN: ST. LOUIS, MO. • PITTSBURGH, PA. • MEADVILLE, PA. • JERSEY CITY, N. J. • NILES, OHIO • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

NEWS SUPPLEMENT OCTOBER, 1947

Equipment
Personnel
Literature

Iron AND Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

JONES AND LAUGHLIN OPENS LABORATORY TO STUDY IRON ORE PREPARATION

▲ Scientific iron ore preparation is advanced by the opening of Jones and Laughlin Steel Corporation's new ore research laboratory in Negaunee, Michigan, a location adjacent to large undeveloped J & L holdings of ore in the district.

The laboratory building, of brick and concrete construction and providing about 13,000 sq ft of floor space, is equipped with facilities for investigation and pilot plant processing of Jones and Laughlin ores.

The front of the building contains eight rooms. Research carried out in this section is on a small scale and of a precise nature to provide background information on the ores. Included in this part of the building are two offices, a machine shop and laboratories for chemical analysis, microscopy, flotation research and sample preparation.

The rear of the building comprises one large shop where investigations may be carried out on a pilot plant scale. From such research come the actual flow sheets for subsequent plant processing of the huge tonnages of ore involved. In this shop is located modern equipment for investigating iron ores from the initial step of crushing and grinding, through the various beneficiating operations to the final sintering or other agglomerating treatment of the ore.

Crushing equipment is so designed that on feeding the first machine, the ore passes automatically through all succeeding machines, is screened and discharges into bins. Adjustments in the crushing machines and in the screens permit the production of different sized products. Each of these machines can be used individually if desired.

Adjacent to the crushing equipment is a convertible-type grinding mill. This mill can be changed from a ball mill to rod mill and vice versa, providing the type grind most suitable for the ore in question.

Sizing operations are an important part of ore treatment. The laboratory is equipped with screens for coarser material and the most modern machines for fine sizing. Such machines include rake classifier, hydroseparator, and hydrosizer. These size the ore in accordance with the rate of settling of grains in water, the coarser settling faster than the finer. Extremely fine materials are handled by the infrasizer, which utilizes the rate of settling of grains in air.

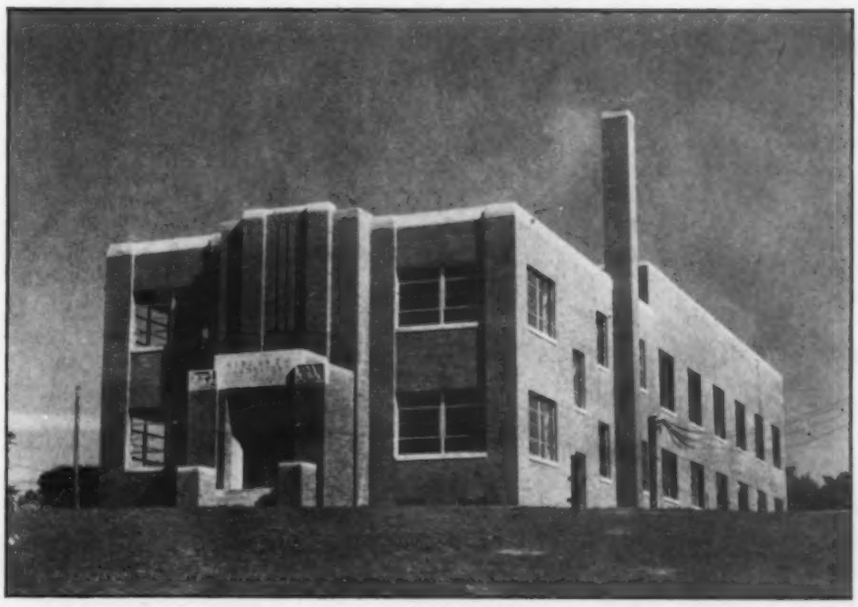
For the actual beneficiation of the ore, the modern types of concentration machines are included. Gravity concentration functions according to the rate of settling of minerals of different specific gravities in water. Machines used for this method are the rake classifier, the hydrosizer, the jig, spirals, shaking table, and heavy density cone. Magnetic separation depends on the motion of magnetizable grains in a magnetic field. Two types of magnetic separators are included in the laboratory, the belt type and drum type.

RELINE BLAST FURNACE IN FORTY-FOUR DAYS

▲ After a thorough study of methods utilized by several steel companies in blast furnace relining, Great Lakes Steel Corporation used a combination method to accomplish a relining in 44 days rather than the conventional 90 normally required. This time-saving resulted in a gain of 45,000 tons of pig iron production.

Cost of relining the furnace, the

This new ore research laboratory is equipped with facilities for investigation and pilot plant processing of J & L ores.



plant's B unit on Zug Island, in the 44 days was $600,000. The furnace has a daily production capacity of 1250 tons.

A brief furnace relighting ceremony was planned for 10 a.m. September 5. However, the furnace didn't wait. The previous day, the furnace was filled with coke to the bottom of the tuyeres and 8000 lb of charcoal in bags was distributed around the 16 tuyeres. Then they started to fill the furnace with ore, coke and limestone with the expectation that it would be full to 12 ft below the closed bell by by 6 a.m. Friday, September 5.

At 11:30 p.m. on Thursday, when the furnace men were making up the iron runner, sparks came out of the iron notch through which a pipe had been installed to permit furnace gas to come out and dry up the clay trough after it had been lighted. At 12:20 a.m., fire was showing at No. 5 tuyere. It was too well lighted to smother out with steam. This premature lighting has not effected the furnace operations in any way. All equipment had been previously tested and operated and functioned perfectly. The carbon bottom apparently retained enough heat from the hot blast used to dry out the lining to ignite the charcoal and the dry wood ties protecting the pipe through the iron notch.

The record rebuilding was made possible through a cleaning method by which complete draining of the salamander was accomplished, so that no blasting was necessary; and by employment of unusually large crews of efficient workmen. An average of 200 men were on the job daily. Special ventilating equipment was installed for workers in the hearth, which has a diameter of 27 ft, 3 in. and is 105 ft tall.

In accomplishing the record, carbon block crews laid 550,000 lb in 32 hours, a job normally requiring four days. Bricklayers laid 650,000 nine-inch bricks in 11 days, compared with usual time of 18 days.

After repair, this gate valve was tested up to 1750 psi with no leaks.

HEATLESS REPAIR SAVES MACHINERY

▲ During the war years an ingenious mechanical repair was developed by Metalock Repair Service to salvage broken and wrecked machinery which failed due to heavy overloads required at the time. The Metalock cold mechanical repair now fulfills a long felt need in the heavy industries. Perhaps the most outstanding feature of the method is that a fractured section in gray cast iron can be repaired with greater than one hundred per cent joint efficiency in many cases. This feature makes possible the repair of sections which failed due to design deficiencies and to the necessity of operation under overload conditions. It is usually impossible to accomplish this with ordinary fusion methods such as welding and brazing, and a repair is inefficient by fusion methods where the materials are not considered "weldable quality" as cast iron or high alloy steels.

The Metalock methods depend upon selective redistribution of operating stresses and reinforcement by transferring high local stresses to heavier, lower stressed sections. Since heat is not used, the objectionable features found in fusion methods such as warpage, reduced physical properties in the parent metal adjacent to the fusion line, and shrinkage fractures are not encountered in Metalock repairs.

Illustrated is practical proof of the joint efficiency obtained in a typical Metalock repair. This test which was conducted by the U. S. Navy consisted of sawing the 200 psi standard valve body through the bottom. A repair was made along the cut and one inch beyond the ends. Hydrostatic test pressure of 2250 psi (ten times working pressure) ruptured the valve body beyond the repair, leaving the repaired area intact. The new fracture was repaired and tested to over five times the design pressure with no sign of distress. This severe test also speaks well of the design of the Fairbanks valve used in this instance.

Metalock has just opened a general office in Pittsburgh, Pennsylvania, known as the Pennsylvania division office.

GENERAL ELECTRIC OPENS NEW PLASTIC PLANT

▲ A new General Electric plastics manufacturing plant at Coshocton, Ohio, which more than doubles the company's capacity for the production of laminated plastics products was officially opened on September 13.

Said to be the largest factory of its kind in the country, the new plant replaces former G-E facilities at Lynn, Massachusetts, and at the present time employs approximately 600 workers, the great majority of whom were recruited from Coshocton and vicinity.

Designed and built by the Austin Company, the plant comprises three buildings with the principal manufacturing building consisting of 235,820 sq ft. Other buildings include a power

The modern plant includes 3 buildings: a manufacturing building, a power house, and a plastic varnish plant.

house and a plant for the manufacture of plastics varnishes.

The manufacturing facilities in the new plant are modern and complete. Largest press is a 5000 ton affair capable of producing laminated sheets 50 by 100 in. This is believed to be as large as any available press of its kind in the country and has many added refinements. Another giant press forms sheets 30 by 110 inches while other presses range from 10 to 1800 tons.

One of the interesting features of the new plant is that its electric substation with two 5000 kva units gives the factory a greater power potential than that required by the city of Coshocton itself. The daily water consumption likewise rivals that of the entire city.

AIR-FUEL CONTROL NEEDS NO HYDRAULIC PIPING

▲ Complete Leeds and Northrup temperature and combustion control systems for large industrial furnaces now include a new air-fuel ratio controller which has the features of simplicity, accuracy and sensitivity. Like the "Micromax" pyrometers and L & N furnace pressure controllers with which it operates, this controller employs electric-motored valve drives — needs no hydraulic piping.

This controller is a rugged, balance-type instrument, having ample flexibility to meet any operating condition. Its ratio can easily be adjusted manually for operation with fuels of various Btu content. As fuel flow changes, the instrument maintains air-fuel ratio constant at the desired control point. Or, it can provide automatic variation of ratio, increasing or decreasing the per cent of air at reduced fuel flows.

The instrument mounts readily on the furnace panel along with other L & N control instruments.

CLAIRTON WORKS BUILDS 85 NEW COKE OVENS

▲ Carnegie-Illinois Steel Corporation, subsidiary of United States Steel, today announced the award of a contract to Koppers Company, Inc., for construction of a new battery of 85 by-product coke ovens and the re-

KRANE KAR REDUCES THE COST OF HANDLING STEEL TO 8¢ per TON

Kropp Forge reports: "Up to a quarter million pounds of steel are moved in an 8-hour day with *KRANE KAR*." A midwestern foundry reports: "*KRANE KAR* can unload 50 to 55 tons of pig iron and malleable steel in 3 hours." At a ball bearing plant, *KRANE KAR* unloaded 50 tons of tubing from a box car and transferred it to a truck in 3 hours . . . under adverse operating conditions.

***KRANE KAR* Lifts, Swings, Carries, and Places Loads—iron and steel stock and forms of any shape or size up to 10 tons. Handles cores, flasks, sand boxes, billets, blooms, castings, bars, sheets, forgings, heavy machinery, etc. 9 to 37 ft. booms or adjustable telescopic booms; pneumatic or solid rubber tires; gas or Diesel . . . Electric magnet, clamshell bucket, and other accessories available. *KRANE KAR* also speeds plant maintenance and repairs.**

USERS: Bethlehem; Birdsboro Steel; Carnegie-Illinois; Coeur d'Alene; Fargo; Harrisburgh Steel; Ohio Steel; United Eng. & Foundry; U. S. Steel, etc.

Send for Bulletin No. 69

THE ORIGINAL SWING-BOOM MOBILE CRANE WITH FRONT-WHEEL DRIVE AND REAR-WHEEL STEER

1½, 2½, 5, AND 10 TON CAPACITIES

KRANE KAR

TRADE MARK REGISTERED

SILENT HOIST & CRANE CO., 872 63rd ST., BKLYN 20, N. Y.

ADVANTAGES OF WING REVOLVING UNIT HEATERS

1. Makes workers feel comfortable, live and invigorated — more productive.
2. Reaches over and around obstructions and into out-of-the-way corners.
3. Moving discharge heats up plant quickly on cold mornings.
4. Reduces absenteeism due to colds resulting from drafts, chills or overheating.
5. Is an excellent cooling system in summer with steam off and fans on.

Wing

REVOLVING

UNIT HEATERS

insure complete

HEAT COVERAGE

NOT just another unit heater, the WING REVOLVING HEATER is unique in that it does what no other heater can do—its slowly revolving outlets gently distribute the heat continuously in a constantly changing direction. It reaches over, around and under obstructions and into out of the way corners. WING REVOLVING HEATERS are in many of the country's leading industrial plants.

L. J. Wing Mfg. Co.

142 W. 14th ST., NEW YORK 11

FACTORIES:

NEWARK, N. J. *MONTREAL, CAN.*

building of a 61-oven battery at its Clairton, Pennsylvania, works.

This new construction, which closely follows the completion of the rebuilding of two batteries at the Clairton plant, is one of the important projects in United States Steel's postwar program of modernization and expansion.

Work will start immediately on the new 85-oven battery and it is expected to be completed by November, 1948. The rebuilding of 61-oven No. 18 battery will commence next year and should be completed approximately 14 months after construction is started.

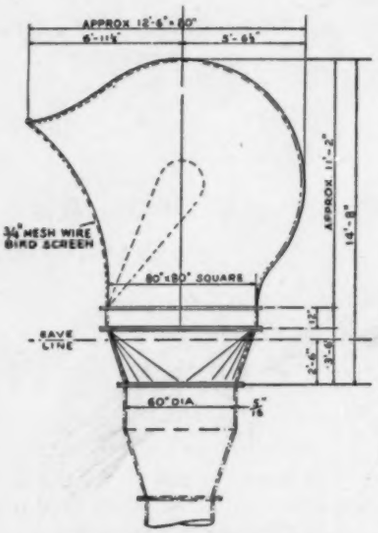
The contract for the new battery also provides for building coal and coke handling equipment, machinery and auxiliary equipment of the most modern design.

The new battery at the Clairton coke plant, already the largest producer of coke in the world, will bring the total number of ovens there to 1567. Coal carbonization will be increased by approximately 1500 tons a day when the new battery is completed.

NEW AIR INLET HOOD FOR TURBO-BLOWERS

▲ A new air inlet hood for turboblowers has been thoroughly streamlined in all its various parts. The construction is such that the walls and the baffle element are properly contoured to give maximum intake efficiency at low as well as high velocity; the throat is so constricted as to provide for an increase in the efficiency and velocity of the air induced.

In other types of inlet hoods there



Intake Hood (Patented)

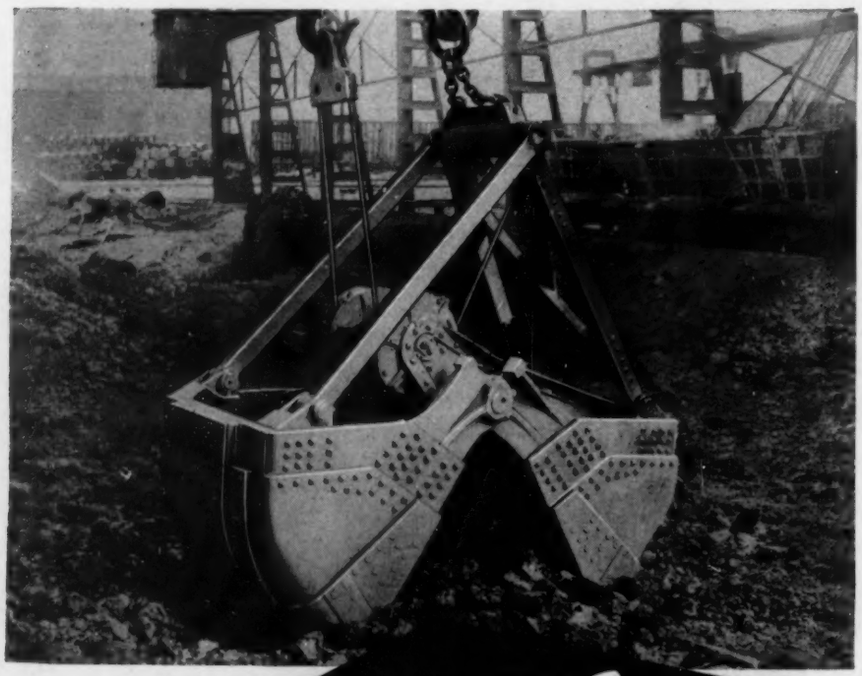
Static pressure tests show this hood induces highest possible volume in low velocities.

are usually one or more regions of turbulence in which no induction takes place and this turbulence robs the incoming air of an appreciable amount of its kinetic energy.

Static pressure tests show the American-Larson Ventilating Company hood induces highest possible volume in low velocities. In high velocities the hood approaches very nearly the perfect.

The curved roof plate from the lip of the opening greatly lessens or even eliminates the vena contracta and turbulence adjacent to the opening. It is designed for varying conditions of use and control. Sketch shows it used as a stationary air inlet before venturi tube. Applied in this manner it will replace many inefficiently de-

(*Please turn to page 108*)



PICK THE RIGHT BUCKET

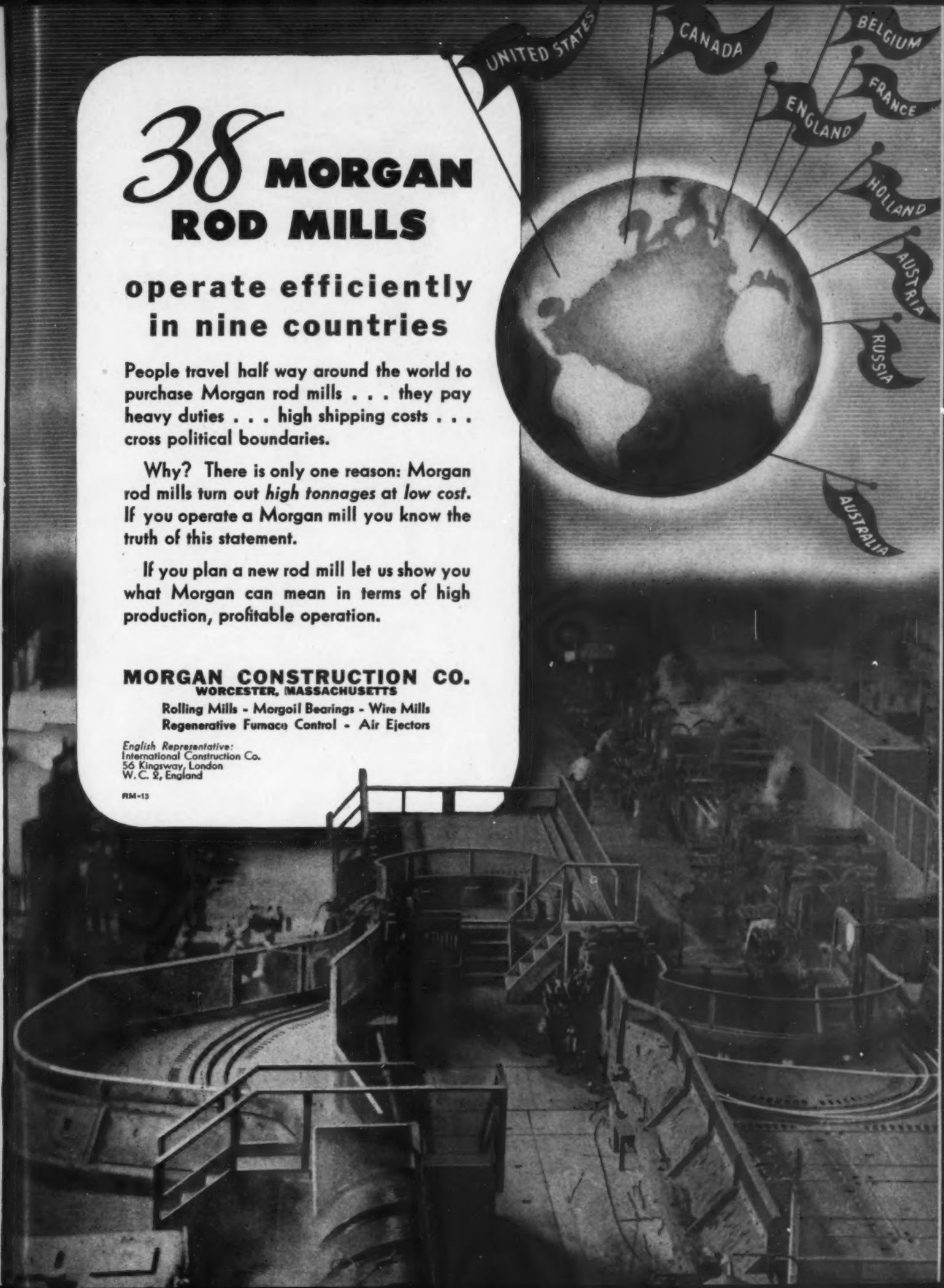
THIS CATALOGUE HELPS!

With hundreds of Blaw-Knox Buckets to pick from, it is easy to select exactly the right one for your conditions if you use Blaw-Knox Catalogue No. 2002. It lists factors to be considered and illustrates typical methods of installation.

The two-line hook-on type shown is one of those particularly adapted to slag handling in open hearth service. Other types, sizes and variations are described.

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
2015 Farmers Bank Bldg., Pittsburgh 22, Pa.

BLAW-KNOX CLAMSHELL BUCKETS



38 MORGAN ROD MILLS

operate efficiently in nine countries

People travel half way around the world to purchase Morgan rod mills . . . they pay heavy duties . . . high shipping costs . . . cross political boundaries.

Why? There is only one reason: Morgan rod mills turn out *high tonnages* at *low cost*. If you operate a Morgan mill you know the truth of this statement.

If you plan a new rod mill let us show you what Morgan can mean in terms of high production, profitable operation.

MORGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS

Rolling Mills - Morgoil Bearings - Wire Mills
Regenerative Furnace Control - Air Ejectors

English Representative:
International Construction Co.
56 Kingsway, London
W. C. 2, England

RM-13

(*Continued from page 106*)

signed pent houses or other types of protected inlets.

This hood is made by the American-Larson Ventilating Company, 1004 Keystone Building, Pittsburgh, Pennsylvania.

ALLEGHENY LUDLUM BUYS WAA PLANT IN DUNKIRK

▲ Allegheny Ludlum Steel Corporation has notified the War Assets Administration that it accepts their counter proposal for sale to the company of Plancor 99, government constructed steel plant operated by Allegheny Ludlum during the war in Dunkirk, New York. The counter proposal agreed to sell the plant to Allegheny Ludlum for $1,500,000 and the company agreed to pay cash. On three previous occasions, Allegheny Ludlum had bid $1,250,000 for the plant. Its first bid was high and, although other bids were higher on the second occasion, none was acceptable to the WAA.

Known as the Allegheny Ludlum Brigham Road plant during the war, the facility was designed especially for the production of bullet core steel.

The company plans to spend more than $500,000 in converting the plant for the production of stainless steel wire. When at capacity operation, more men will be employed at the plant than at any time during the war.

Acquisition of the facility is in line with the company's plant improvement program. The present wire plant, known as Lucas Avenue, will be moved to the previous war plant. The union has agreed to give the company full cooperation in operation of the new facility.

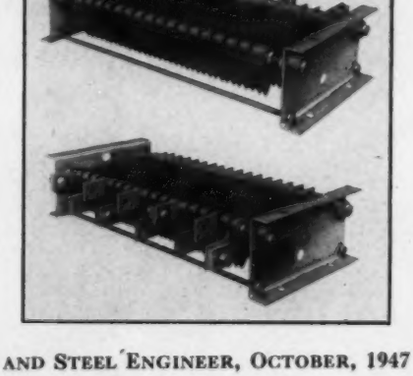
WELDED RESISTOR-ENDS FORM CONTINUOUS PATH

▲ For use in electric motor controller and starter duty, Electric Controller and Manufacturing Company announces a new line of non-breakable resistor-sections in which resistor-ends are offset and spot-welded together to form a continuous path throughout the section. Terminal-plates for external connections are also welded in place.

Known as "Tab-Weld" plate resistors, the individual resistors are stamped in the form of grids from flat-rolled, corrosion-resistant, chromium alloy steel. This material has a negligible resistance-change between cold and maximum temperatures. After flat-stamping, the end-convolutions of each grid are offset, one end to the right and the opposite end to the left. When placed on the supporting rods, these offset resistors form a zig, zag pattern, bringing the ends of two adjacent resistors into intimate contact on one side and separating them on the opposite side of the section. Moulded insulating spacers, which will not soften below 2000 F, are used between the separated ends.

Each resistor has a tab at each end

The individual resistors are stamped in the form of grids from flat-rolled, chromium alloy steel.



BUT...

It would be of little value in turning out the volume of high quality work scheduled and delivered by today's printing plants. In the field of pickling

Rodine

has made comparable results possible. A small amount of RODINE, added to either sulfuric or muriatic pickling baths, assures precision control and at the same time saves good metal from attack, prolongs the effective life of the bath and reduces acid wastage. Over-pickling and hydrogen embrittlement are held to a minimum. Scale-removal is greatly facilitated.

For better pickling and more pleasant working conditions—use RODINE.

CHEMICALS ACP PROCESSES

RUST PROOFING AND PAINT BONDING
Granodine *
Duridine *
Alodine *
Lithoform *
Thermoil-Granodine *

RUST REMOVING AND PREVENTING
Deoxidine *
Peroline *

PICKLING ACID INHIBITORS
Rodine * ®

AMERICAN CHEMICAL PAINT CO.
AMBLER ACP PENNA.

which extends below the grid-eyes and supporting rods. On one side of the section, terminal-plates are placed on the supporting rods at frequent intervals against the mated resistor-ends. These terminal-plates also have tabs to match with the resistor-tabs. All adjoining tabs are spot-welded together to form a continuous path from one end of the section to the other. This welded construction prevents burning at the grid-eyes or taps.

Terminal clamp-blocks supplied with these resistor-sections, have grooves to accommodate several sizes of wire. They are bolted to the terminal-plate and are readily movable from plate to plate to provide the desired resistance between steps. If flat bus is preferred for external connections, it may be bolted on by the four holes in each terminal-plate.

Internal nuts on the supporting rods clamp the grid-stack independently of the end-frame clamping. Accurate mounting-hole dimensions, for installing sections one on top of the other, are maintained regardless of the grid-stack length. Sections are available in several capacities and are of the same width, length and height. Standard mill sections are built with the same size resistors per section.

BLISS EXPANDS CAPACITY AT SALEM, OHIO, PLANT

▲ E. W. Bliss Company is increasing the capacity of its Salem, Ohio, plant. Approximately $350,000 worth of modern machine tools will be added to the plant and several buildings rehabilitated to yield 33 per cent more floor space for machining and assembly.

Domestic and foreign demand for rolling mills, material handling equipment and mill accessories have increased so rapidly that present facilities are inadequate.

Included in the new equipment is one of the largest planers in the middle west as well as two giant lathes. Skilled technicians of all types are being transferred from the Brooklyn, New York plant, which will be closed on January 1, 1948.

This is the second expansion at Salem in 18 months. At that time, a modern factory was established to produce weldments used in the construction of rolling mills and metal stamping presses.

NEW "SKYLIFT GIANTS" HAVE 30 TONS CAPACITY

▲ The world's largest fork and ram trucks, the new "Skylift Giant" series, are now in production at Automatic Transportation Company. Completely new in design, these new trucks range from 10 to 30 tons in capacity. The newest in a tradition of automatic heavy duty trucks which began a decade ago with the world's first 15,000-lb capacity ram truck, the 60,000-lb capacity Automatic is more than twice as large as any other fork or ram truck ever built.

First trucks in the new series, a 30,000-pound unit, came off the assembly line in September for delivery to one of the nation's largest steel mills. Following it is a full schedule of production of units for delivery to all major steel mills in the United States and Canada.

In addition to steel mill operations, the new giant is designed for die-handling and similar functions in automotive and other heavy-industry.

No other one instrument

PERFORMS ALL THESE FUNCTIONS

INDICATE AIRFLOW

INDICATE FUEL FLOW

SHOW RATIO OF AIRFLOW and FUEL FLOW

The Hays Visio-Ratio Gage is unique among indicating instruments because it performs the functions of three indicators—air-flow, fuel-flow and ratio.

Illustrated is a Visio-Ratio Gage which measures the flow of gas to a gas fired industrial furnace and the flow of air used for the combustion of the gas. Both these scales are calibrated in rate of flow in 1000 cu. ft. per hour.

The center scale is calibrated to show the percentage of excess of deficiency of air used to burn the gas with a range of 30% deficiency to 50% excess.

The spot at which the pointers cross over the center scale indicates directly the percentage of excess of deficiency of air used for combustion, eliminating the mathematical calculations which otherwise would be required with each change in flow of gas or air. The ratio used depends on the type of flame desired– oxidizing or reducing.

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

Type MT — single pole, electrically operated breaker. Application range: 250 and 750 V. D-C. Interrupting rating is 150,000 Amp. in capacities 2000 and 4000; 250,000 Amp. in capacities 6000 and above.

Only *Switchgear Specialists* can give your vital equipment protection like this . . .

I-T-E Type MT Automatic Reclosing Air Circuit Breaker *(for Pedestal mounting)*

Short circuits and overcurrents in the power distribution systems of steel mills and electrolytic plants can wreak havoc on vital equipment. Rolling mill generators, motors, rectifiers, heavy-current feeders, and synchronous converters are easily damaged and expensive to replace. Production shutdowns for repairs can be costly.

With these facts in mind, I-T-E—*specialists in quality switchgear*—designed and built the Type MT Automatic Reclosing Circuit Breaker—a unit of dependable, full-time protection for heavy-capacity equipment. The quick-acting MT interrupts extremely heavy direct-currents in about 1¾ cycles (60 cycle basis) at 25% to 100% of interrupting rating; clears shorts rapidly, dependably.

The I-T-E *Rate-of-Current-Rise Trip* anticipates extremely high currents. It distinguishes between a useful load of high value and a dangerous fault current, and trips the breaker before the danger peak is reached, preventing possible damage to cables and equipment.

Electrically and mechanically trip-free on overcurrent, the MT trips immediately when closed on a fault. All tripping devices are direct-acting and instantaneous. A specially designed, self-energizing buffer mechanism smoothly absorbs shocks of opening—prevents sticking or bouncing. Magnetic blow-out coil and arc extinguisher provide for rapid, safe extinction of arcs under all current conditions.

The MT is normally built in two styles: pedestal mounted, and panel mounted. Pantograph drawout, and truck mountings can also be furnished when required. Each style has the same sturdy frame of hot-rolled steel, formed and welded into a rugged, protective support unit.

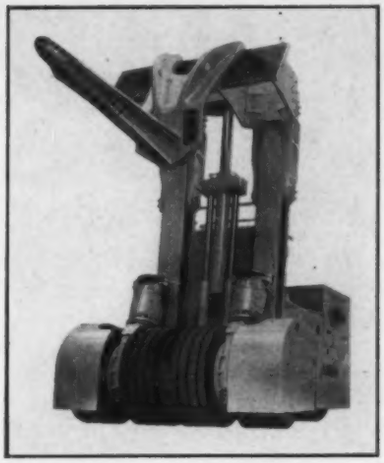
Complete details on the I-T-E Type MT Automatic Reclosing Air Circuit Breaker are contained in illustrated catalog 2201. Send for your copy. *The I-T-E representative in your locality will be glad to advise you on applying the MT—and other I-T-E protective equipment—to your electrical distribution system. Use his services with no obligation.* I-T-E Circuit Breaker Company, 19th & Hamilton Streets, Philadelphia 30, Pa.

31 OFFICES IN UNITED STATES AND CANADA

I-T-E **MILL TYPE SWITCHGEAR**

The Leader In Technical Excellence

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • AUTOMATIC RECLOSING CIRCUIT BREAKERS HIGH SPEED CIRCUIT BREAKERS



Designed in answer to advancing steel mill processing methods which require the handling of larger and larger coils, the new trucks will range in capacity from 10 to 30 tons. Model above is a 15-ton unit, which has already been delivered to and is at work in one of the nation's largest steel mills.

Designer of giants is B. I. Ulinski, chief engineer of Automatic's truck division, designer of the largest industrial trucks built during the past 15 years. His "firsts" include 30-ton capacity low-and high-lift platform trucks which are still the largest units of their kind in existence.

The first trucks to be so designed, the giants are each powered by a four-wheel front drive assembly, with twin drive units for the two pairs of wheels. Because of this design, the truck is approximately 20 per cent lighter in proportion to load capacity than any previous heavy duty fork and ram truck.

The drive units operate through fully enclosed helical bevel and spur gear reduction. Like all vital operating parts on the truck, however, the units are immediately accessible for maintenance. Efficient maneuverability is provided through full differential of the four drive wheels — mechanical differential between the two wheels of each drive unit and electrical differential between the two units.

Each of the two drive unit axles is pivoted to provide complete compensation for roadway obstructions, providing constant four-wheel traction regardless of floor conditions.

The new truck is the first and only heavy duty industrial truck with high-pressure hydraulic lift. Of original design, the lift operates through a multiple-action three-cylinder ram pushing directly against the cantilever, eliminating chains, sprockets and other forms of lift multiplication.

Built to keep handling methods abreast of advancing steel mill processes, as well as other heavy industry operations, the trucks are all engineered to handle the widest steel coils now being produced. Their inch-pound rating is more than sufficient to handle its rated load capacity in coils as wide as 108 in.

The truck's trailing axle is of the castor type, preventing transmission of road shock and compensating for uneven floor conditions.

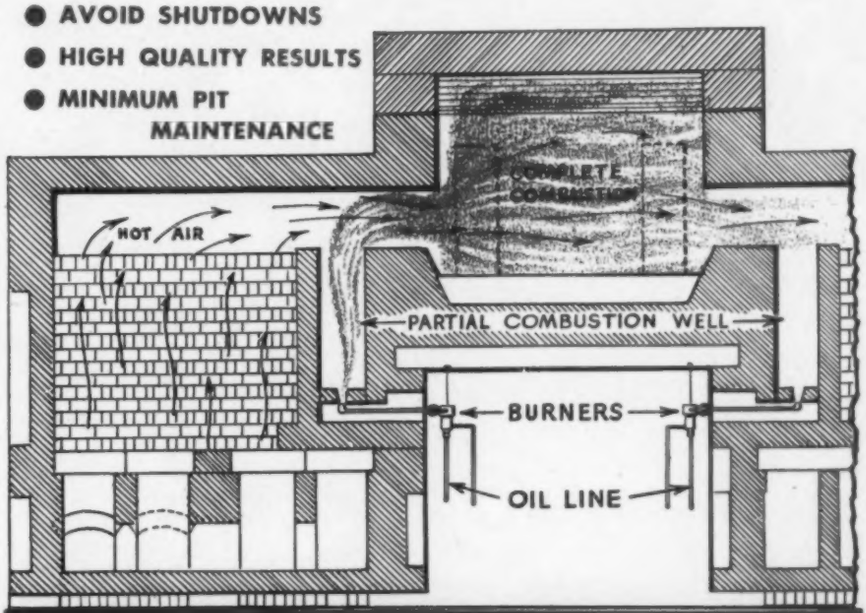
COLUMBIA STEEL TO BUILD COLD REDUCTION MILL

▲ Columbia Steel Company, a United States Steel subsidiary, announced recently that a cold reduction mill with a capacity to produce over 300,000 tons of sheets a year will be built by that company in the Los Angeles area. It is hoped that construction of the new mill will be completed by the end of 1949, provided no unforeseen delays occur.

(*Please turn to page 113*)

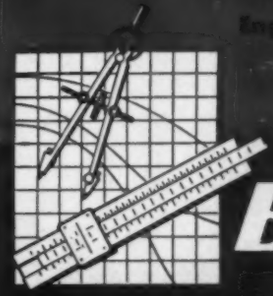
Burn Oil IN REGENERATIVE SOAKING PITS by BLOOM method

- AVOID SHUTDOWNS
- HIGH QUALITY RESULTS
- MINIMUM PIT MAINTENANCE



The Bloom method for all firing of regenerative soaking pits gives quality heating that compares favorably with gas operation. The installation is such that gas or oil can be used interchangeably.

This is another example of how Bloom Engineered applications can serve industry.



BLOOM ENGINEERING CO.

857 W. North Avenue Pittsburgh 12, Pa.

Another TORRINGTON *Special*

EDGE TRIMMING MACHINES

MODEL 1049
Maximum Trimmed Width 64"
8" Diameter Cutters

MODEL 1049 is one of 9 standard models of Edge Trimming or Splitting and Trimming Machines made by The Torrington Manufacturing Company. Edge Trimming Machines shear off the edges of strips or sheets of metal to provide uniform width. Several sizes include a third pair of cutter blades so that the material may be cut into two strips.

The principal advantage of these machines is the ease of adjustment for width. The sets of cutter units are slidably mounted on ways, and can be adjusted for width in unison or independently, manually or by motor. The 9 standard machines handle a wide range of thicknesses and width and any of them can be adapted to special needs, as necessary.

This type of machine is only one of many special machines for processing sheet, strip, flat wire, rods and tubes that Torrington has been designing and building for over 60 years. All standard designs can be readily modified to meet special requirements. Our highly trained design and engineering staff and all the facilities of an extensively equipped, modern plant are at your service.

Privacy is guaranteed when we work with or under the supervision of customers. All materials and workmanship are guaranteed.

Call or write Torrington Manufacturing with complete details of your requirements. We'll build a machine to suit *your* specifications and will also help set it up and start it in production.

EDGE TRIMMING MACHINE
1049

FEATURES

CAPACITY: (Metal at 30,000 lbs. P. S. I. Shear Strength.) Maximum Thickness .160", Trimmed Width Minimum 4", Maximum to suit.

SPEED varies with power available, type of bearings and production requirements. 200 R. P. M. is nominal but not maximum speed. Anti-friction bearings permit speeds up to 1,000 R. P. M.

CUTTERS: Alloy tool steel, hardened and ground to suit material. 8" Max. Dia., 7" Min. Dia., Thickness ¾".

ADJUSTMENT of cutter units for width is simple and can be done independently or in unison. A graduated scale is used to determine the setting and each unit is locked to ways when properly located. Upper arbor of each cutter unit is vertically adjustable to suit wear of cutters and various gauges of material.

GUIDES: At entry and exit are included. Also mounting for stripper fingers.

DRIVE: Drives cutter blades through speed reduction to drive shaft; thence through pinions in compensating arrangement, to each arbor.

ATTACHMENTS may be added—driven feed rolls at entry; driven idle or deburring rolls at exit and rotary or star-type scrap cutters.

AUXILIARIES include drum-type take ups for thinner gauges and 3-roll type coilers for heavy metal.

The **TORRINGTON**
MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT

(*Continued from page 111*)

In addition to cold reduced sheets, the new mill also will be equipped for hot rolled sheet processing and for sheet galvanizing and coating, in order to meet the West Coast demand for these types of products.

In August, 1945, United States Steel announced that studies were being made with a view to modernizing Columbia's steel facilities in the Los Angeles area. A modern cold reduced sheet mill was a part of that contemplated program.

It is expected that the new mill will employ about 1500 men and will cover 150 to 200 acres.

The Torrance mill of Columbia Steel Company in the Los Angeles area, which has been in operation for 30 years, produces merchant bars and light structural shapes, among other products. The operation of the Torrance mill will be continued.

It is expected that raw materials for the new cold reduction mill, principally in the form of semi-finished steel in coils, will be shipped to a large extent from the Geneva steel mill at Geneva, Utah, which U. S. Steel purchased last year from the government.

This new mill will give Southern California and nearby territories access to a largely increased supply of important steel products manufactured in that same area.

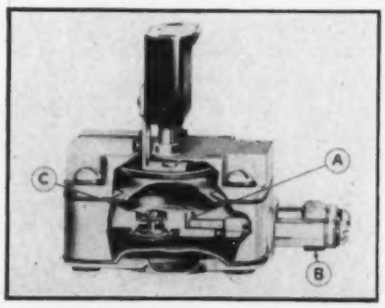
PNEUMATIC TIMERS GIVE WIDE RANGE TIME LIMIT

▲ Square D pneumatic timers provide wide range time limit acceleration, unaffected by normal variations in ambient temperature and voltage conditions. Danger of timing error as the result of friction between surfaces or moving parts, mechanical wear or foreign material on magnet surfaces, has been completely eliminated.

Air is transferred from lower chamber through metering orifice (A). Rotation of knurled wheel (B) gives wide range of adjustment. The air returns through valve (C) for instantaneous reset. Timers may be coupled to contactors or actuated by separate magnets.

Pneumatic-time acceleration permits motors to be brought to speed quickly and smoothly, regardless of load conditions. Operators become "tuned" to accelerating speeds and are better able to accustom themselves to the response of several different motors operated in sequence, as the result of uniform adjustment.

Timers may be coupled to contactors or actuated by separate magnet.



ELECTRONIC CONTROLS FOR MECHANICAL MECHANISMS

▲ An automatic electronic remote control and positioning unit for the control of valves, dampers and other mechanical mechanisms is announced by the Askania Regulator Company. The basic units which make the com-

Meet Your Pump Requirements with Matchless Peerless Performance!

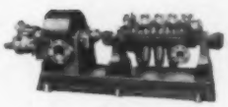
PEERLESS PUMPS

PEERLESS CENTRIFUGAL PUMPS

Manufactured in An Extensive Range of Types, Sizes and Capacities to 70,000 G.P.M.

Descriptive Bulletins Available—Request Your Copies

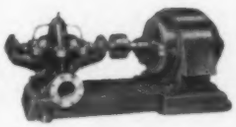
BOILER FEED SERVICE



PEERLESS TYPE B PUMPS

Peerless Type B multi-stage pumps are designed for boiler-feed, pipe line and refinery services delivering capacities up to 900 g.p.m. against pressures up to 700 lbs. For electric and other type drives from 60 to 350 h.p.

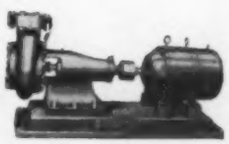
GENERAL SERVICE



PEERLESS TYPE A PUMPS

Peerless Type A pumps afford top-flight, continuous duty operation with capacities from 50 to 70,000 g.p.m. Heads: 15 to 300 ft. All types of drives: 1 to 1000 h.p. Sizes: 2" to 42" discharge. Split-case, single stage, double suction type.

PROCESS SERVICE



PEERLESS TYPE DS PUMPS

Peerless Type DS is the ideal pump for chemical, oil, soap and similar process services. Capacities: 10 to 1500 g.p.m. Heads: up to 231 feet. Handles a wide variety of corrosive or non-corrosive liquids at temperatures to 200° F.; single stage, single suction.

FIRE PROTECTION

PEERLESS FIRE PUMPS

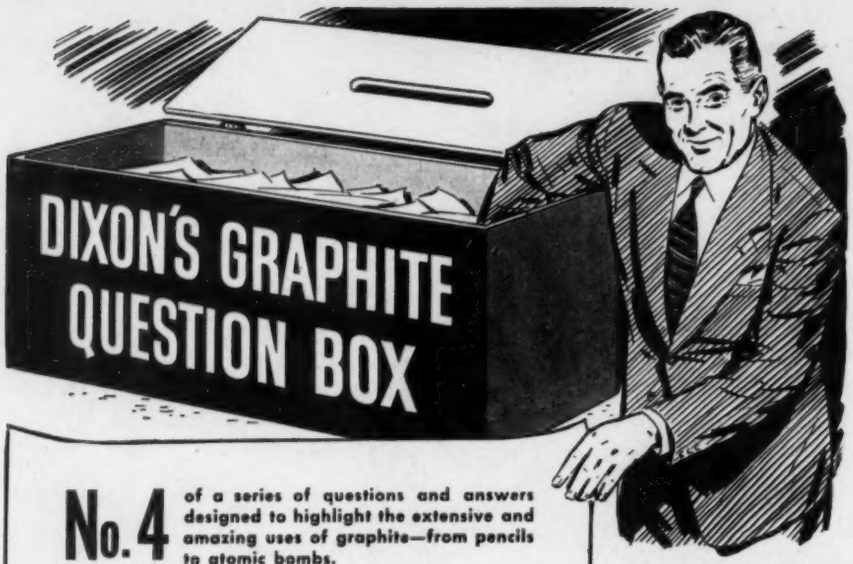
Peerless Underwriters' Approved fire pumps are available for all fire protection services. Capacities: 500 to 2000 g.p.m. Pressures: to 150 lbs.; single and double stage types, for electric, engine, turbine drive or combinations.

PEERLESS PUMP DIVISION

FOOD MACHINERY CORPORATION

FACTORIES:
Los Angeles 31, Calif.; Quincy, Ill.; Indianapolis, Ind.
District Offices: Chicago 40, 4554 North Broadway; Philadelphia Office: Suburban Square, Ardmore, Pa.; Atlanta Office: Rutland Building, Decatur, Georgia; Dallas 1, Texas; Los Angeles 31, California.

FOR MOST SERVICES IN ALL INDUSTRIES



No. 4 of a series of questions and answers designed to highlight the extensive and amazing uses of graphite—from pencils to atomic bombs.

GRAPHITE IN THE ROLLING MILL

QUES. Has graphite a long standing reputation for effectively lubricating cylinder walls of steam and internal combustion engines, including Diesels?

ANS. Definitely yes. One of its earliest applications, graphite is widely used for swabbing the walls while making repairs.

QUES. Is graphite effective in hydraulic pumps, and if so, where?

ANS. It has been an old standby for generations, on pump pistons and piston rods.

QUES. What's behind the age-long practice of coating or impregnating mechanical packings, gaskets and pipe joints, bolts and assemblies with graphite?

ANS. Graphite maintains long lasting lubrication and leakproofness in packings; prevents destructive, corrosive deterioration of gaskets and pipe joint fittings, assuring easy setting up and disassembling even years later.

QUES. Is graphite serviceable as a pigment in protective coatings for equipment subject to excessive heat?

ANS. It is unequalled, and in some formulations also provides an attractive, lustrous, silvery polish, when rubbed.

QUES. Do graphites and graphited lubricants cost more than non-graphited lubricants?

ANS. They cost somewhat more by the pound or gallon but are definitely cheaper in the long run, when measured in terms of ultimate savings in reducing wear on bearings, gears, chains, etc., and time and expense of making more frequent lubricant replacements.

A few of thousands of widely used products containing Dixon's Graphites. If starred they are Dixon's products, many of them sold by supply houses everywhere.

★Waterproof Grease

★ Auto-Marine Grease

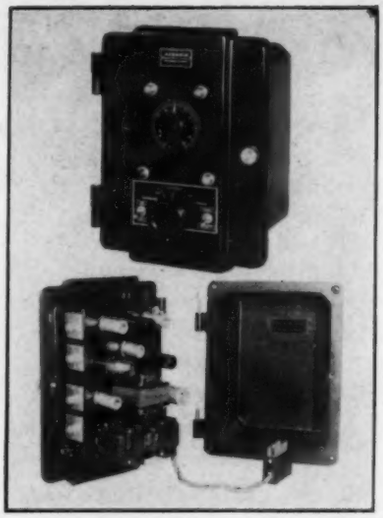
★ Slipstik, Greastik, G-711 Stick

Now may we receive *your questions* on how graphite can help *you?*

DIXON'S GRAPHITES

Products of
JOSEPH DIXON CRUCIBLE COMPANY
Jersey City 3, N. J. Div. 18-Q-10

LOOK FOR No. 5
in this series. We will gladly send you reprints of any you may miss.



Three basic units make possible this flexibility: a transmitter, a control amplifier, and a receiver.

plete system can be combined in a variety of ways to produce systems to meet many industrial remote control needs.

Three basic units make possible this flexibility:

1. A transmitter from which point any desired position of a remote receiver can be selected.
2. A control amplifier, which responds to the setting of the transmitter and accordingly controls the supply of power to the receiver.
3. A receiver, which moves a load to the selected position.

The new "Servo System," though operating with the high accuracy ordinarily available only with laboratory instruments, is constructed for heavy industry use. Strong, dust proof cast metal cases of the transmitter, amplifier and receiver are built to withstand shocks, vibration, corrosion and other tough industrial operating conditions.

CLADMETALS FIRM SPEEDS PRODUCTION PROGRAM

▲ American Cladmetals Company is accelerating its program to produce stainless-copper clad sheets under the Kinney process at its Carnegie, Pennsylvania, plant. Company plans to produce 6 to 8 million pounds of clad metal annually with the equipment it is originally installing.

C. H. Hunt Inc., consulting engineer, Pittsburgh, is laying out the plant, which will include a 42-in. hot

mill stand, a 30-in. cold-reduction unit, and auxiliary equipment.

Specially designed cladding press, now being installed, will handle stainless-copper clad metal on a completely mechanized precision basis. The Kinney cladding processes and techniques make possible the cladding of stainless sheets and strip to copper; two very dissimilar metals with widely different physical characteristics. Stainless-copper clad sheets have been produced as thin as 0.017-in. thick, up to 27 in. wide.

Heat treating practice has been determined which overcomes some earlier difficulties of heat treating the cladded product. The cladded metal has been subjected to extensive heat treatment experiments by reputable fabricators and heat treating specialists, in which various grades of cladded copper and stainless steel were employed. The tests took into consideration a wide temperature range, time cycles, amount of cold work, and type of quench employed. Results indicate that the company's cladded metal can be subjected to a wide range of drawing and forming operations.

BLOOM HEATING FURNACE FOR SPANG-CHALFANT

▲ A new continuous bloom heating furnace with a capacity of 60 tons an hour will be constructed for Spang-Chalfant division of National Supply Company at Ambridge, Pennsylvania, by Rust Furnace Company, according to a contract just announced.

The 70 ft triple-fired, zone controlled, end charged, end discharged furnace will replace old equipment. A brick lined stack to serve the furnace also will be built. The chimney will be 125 ft high with an interior diameter of 6 ft.

This new furnace is in addition to a 100-ton furnace, one of the largest ever to be built for a tube mill, to be constructed by Rust at Ambridge under a contract previously announced.

WELDING ELECTRODES HAVE WIDE FLAME

▲ Speer Carbon Company announces that their new "ACWeld" carbon electrodes, developed for use with a-c welding equipment, are now avail-

Silicone Treated

DELTABESTON* MAGNET WIRES

Provide Remarkable Resistance to High Temperatures

One of the most outstanding developments to come out of General Electric's research laboratory is the new silicone-treated glass-insulated Deltabeston magnet wire. Because silicone resin offers remarkable immunity to high ambient temperatures, this new magnet wire is highly recommended for electric equipment which operates in temperatures in excess of those that can be met with conventional Class B insulation.

The new Deltabeston magnet wires are insulated with a yarn of pure, continuous spun glass that is firmly bonded to the copper with a special silicone compound, to withstand constant, high heat. They are made with either single or double wraps of glass yarn. Silicone-treated Deltabeston is smooth, tough and flexible—particularly suitable for winding motors, lifting magnets, brake coils, generators, and similar applications. It can be wound into the most intricate coils without rupturing the insulation. It's available in round, square, and rectangular shapes in a complete range of sizes.

Do you have a magnet-wiring problem where excessive heat is encountered? You can obtain additional information about silicone-treated Deltabeston by contacting your G-E Deltabeston distributor or by writing to Section Y100-1046, General Electric Company, Bridgeport 2, Connecticut.

*Trade-mark Reg. U.S. Pat. Off.

GENERAL ELECTRIC

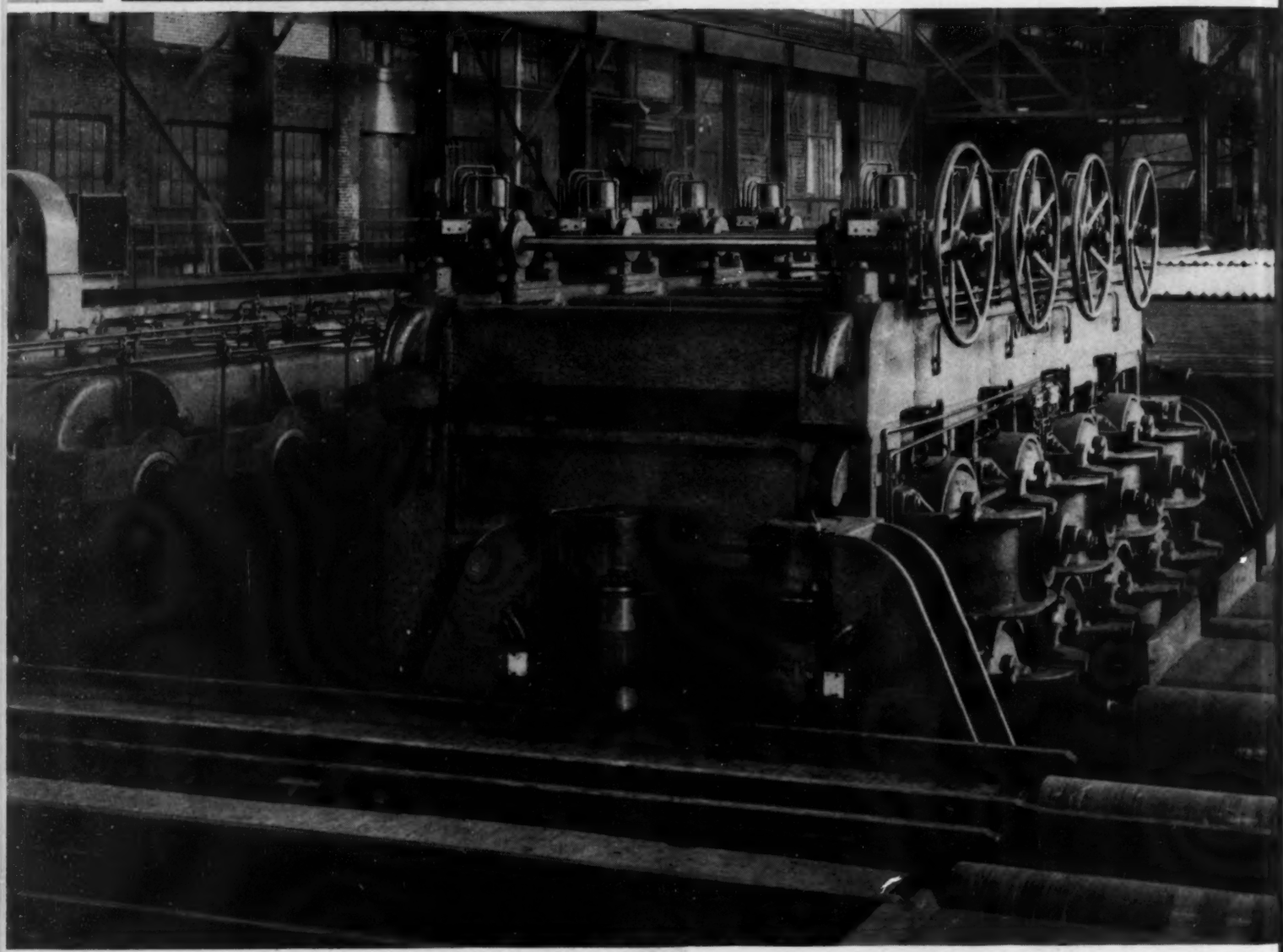
24" I BEAM STRAIGHTENER

BUILT BY MORGAN Engineering

Illustrated is a Morgan Roller Straightener for structural shapes up to 24" I beams.

It is equipped with four top and four bottom rolls, all of which are adjustable. These eight rolls are arranged to be connected by spindles to a separate enclosed gear box drive. All gear shafts are mounted in roller bearings. Vertical rolls are provided on both entry and delivery sides.

A section of roller table is mounted on one side of straightener to be shifted into the roller table line when straightener is not in use.



DESIGNERS • MANUFACTURERS • CONTRACTORS

BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS • ELECTRIC TRAVELING CRANES • CHARGING MACHINES • INGOT STRIPPING MACHINES • SOAKING PIT CRANES • ELECTRIC WELDED FABRICATION • LADLE CRANES • STEAM HAMMERS • STEAM HYDRAULIC FORGING PRESSES • SPECIAL MACHINERY FOR STEEL MILLS

THE MORGAN ENGINEERING CO.
ALLIANCE, OHIO
Pittsburgh 1420 Oliver Building

able. With the proper setting (amperage), it is said these carbons give a clean, wide flame useful in brazing copper and brass tubing, in bending, forming and heat treating, soldering and welding. The carbons are advantageous for work requiring applications of heat by radiation as the radiant heat (9000 F) of the carbon are flame greatly increases the scope of electric welding.

Other stated advantages of the new carbon electrode are: smooth burning with minimum noise; no sparking or sputtering; arc is easily struck and holds the arc longer with the same setting; pure, intense heat supply for welding metal quality is vital.

Cored a-c welding electrodes can be furnished plain, or copper-coated for better carrying capacity and burning qualities when the current is high. The copper plate on the coated electrodes is thick, smooth and uniform.

NEW AXIAL FLOW FANS WITH HIGH EFFICIENCY

▲ A new line of axial flow pressure fans has been announced by the Sturtevant division of the Westinghouse Electric Corporation.

Two basic types of these "Axiflo" fans are available: the straight-through type or the convertible elbow type, both furnished with either the three bladed aluminum alloy wheel or eight bladed steel wheel. Applications for these fans include: air conditioning, dust and fume removal, machinery cooling, mechanical draft for combustion, industrial drying and processing.

Designed for either vertical or horizontal operation, these Axiflo pressure fans have high mechanical and static efficiency combined with large volumetric capacity to perform effectively against resistance of wind and duct systems. Compact in design and sturdy in construction, these new fans offer other special features as less space and weight, high efficiency, straight air flow, and simplified mounting. The convertible elbow type with motor, belt and bearings located outside the air stream, readily accessible for inspection and maintenance, is ideal for high temperature service.

Sizes vary from 18 to 72 in.; static pressures from 0 to 3 in., and displacement from 2000 to 115,000 cfm.

TCI MAIN DRIVE NEARS COMPLETION

When completed, this giant 110-ton synchronous motor, the largest alternating current mill motor ever made by General Electric, will drive a roughing stand of a hot strip mill in the Fairfield, Alabama, plant of the Tennessee Coal, Iron and Railroad Company. The huge 4000-horsepower motor has a rotor weighing 52 tons. It will be rated 6600 volts, three phase, 60 cycle, 78 rpm.

ARTILLERY TYPE BURNER FOR STEEL MILL FURNACES

▲ Crowe Engineering Company is manufacturing a new artillery type water cooled burner for steel mill furnaces. This burner is the result of years of experimentation and is now being used in steel mills coast to coast. Specially designed to place atomized fuel in furnaces for speeding up the melt, this burner is extremely practical and effective during an entire melt down and for melting down scrap.

All artillery type burners are made specifically for the furnace in which they are to be installed by careful analysis and study, and skillful engineering. The artillery type operates equally well with oil, or pitch and gas combination, and as a result many users have made this burner the standard for their open hearths. Any liquid or gas fuel can be used to best advantage.

All burners are equipped with Crowe adjustable atomizers, used and approved by leading steel mills after exhaustive tests. Through their operation the fuel is completely atomized and ejected in a fine spray, not in lumps and gobs. This results in per-

SPC

Designers and Builders of

OIL and GAS COMBUSTION SYSTEMS

to Meet Difficult

INDUSTRIAL HEATING PROBLEMS

From Soaking Pits to Forge Furnaces

SPC

STEEL PROCESSING CO.

FORT PITT BRIDGE WORKS

MEDART MULTICYCLE

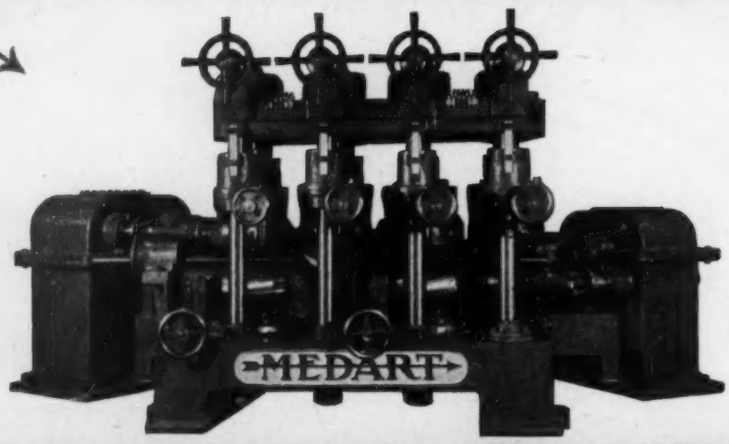
PIPE AND TUBE STRAIGHTENING MACHINE

"6 in 1"

SIX POINTS OF SUPERIORITY IN ONE

1. **MULTICYCLE STRAIGHTENING**—Two bending rolls impose duplex straightening cycles on workpiece insuring end to end straightness.
2. **POSITIVE AND SYNCHRONIZED FEED**—All four feed rolls are driven insuring positive synchronized feed and torque balanced around neutral axis of workpiece.
3. **THE WORKPIECE LEVEL**—Maintains one feeding level for all sizes of pipes or tubes—eliminates need of adjustable entry and delivery tables.
4. **NO GUIDES**—Horizontal position of the six rolls with balanced torque eliminates requirement for guides.
5. **SINGLE MOTOR**—All four driven rolls powered from a single motor, for synchronization and economy.
6. **NO BEVEL GEARS**—All gears enclosed in cases and running in oil, for sure trouble free operation.

"Patents make Jobs"



MEDART

fect combustion of fuels and a marked decrease in time required per melt.

The burner is easy to operate, and can be raised or lowered, and placed in required position quickly. It can be used with or without doghouse. A great number of steel mills, since installation of the Crowe artillery type burner, have abandoned the doghouse, thereby saving themselves expensive brickwork.

COMPACT TRANSFORMER IS LIGHT IN WEIGHT

▲ An improved line of smaller, lighter and more compact distribution transformers with internal assembly patterned upon time proven basic electrical design plus new light weight construction techniques made possible by the use of preferred orientation electrical core steel, has been announced by the Pittsburgh works of the Allis-Chalmers Manufacturing Company. The new design represents a 17 to 46 per cent saving in weight with corresponding reduction in size.

Engineered to meet all the recommendations included in the revised second report of the EEI-NEMA joint committee on the standardization of distribution transformers from 1½ to 100 kva, 2400 through 15,000 volt classes, the improved transformers represent the latest development in the electrical field as well as the latest advancements in metal fabrication and welding.

BOOK REVIEW

▲ "Rolling Technique," which has just been issued as a 64-page Catalog No. 2090 by the Pittsburgh Rolls Division of the Blaw-Knox Company, Pittsburgh, Pennsylvania, is one of the most interesting roll and roll design bulletins which has appeared for some time. The bulletin describes in detail roll uses on 21 different sections or classes of material including: rails, tie plates, splice bars, standard beams, "H" beams, universal shape mills, rounds, rods, plate, strip, blooming and billet mills, "Z" bar, angles, seamless tubes, etc. For each type product, a brief description is given of the mill and the rolls which are recommended for each stand.

Copies may be obtained from: IRON AND STEEL ENGINEER, 1010 Empire Building, Pittsburgh 22, Pennsylvania.

(*Please turn to page 148*)

WHY MILL DRIVES DON'T HAVE MODEL NUMBERS

1500 HP Reversing Reel Drive with cover removed.
150 HP Tube Mill Drive, triple reduction, 113:1 ratio.
10,000 HP Piercing and Expanding Mill Drive.
800 HP Cold Strip Mill Drive.
FARREL

Each rolling mill drive must be designed and built to fit the specific requirements of the job it has to do. Power and speed to be used . . . type and gauge of metal to be rolled . . . process (hot or cold) . . . nature of load (continuous or intermittent) . . . type of drive motor . . . all these are important factors influencing mill drive specifications.

That's why Farrel-Birmingham mill drives are "engineered-for-the-job" instead of being made in standard models on a production line. This means that each drive unit is the result of a careful engineering study and every vital part is of a size and material which provides fully adequate strength to meet the stresses, strains and shocks to which it will be subjected.

FARREL ROLLING MILL MACHINERY

- Rolls
- Rolling Mills
- Rod Mill Tables and Manipulating Equipment
- Universal Mill Spindles
- Rod Coilers
- Gears
- Gear Drives of any Capacity
- Mill Pinions
- Pinion Stands
- Flexible Couplings
- Roll Grinding Machines
- Roll Calipers
- Lead Presses for Pipe or Rod

Housings are of cast steel, Meehanite or welded steel construction, with either double-walled or single-walled deep base, depending on requirements. They are proportioned to maintain accurate alignment of all shafts despite continued stress and strain.

The gears are usually continuous tooth herringbone — the famous Farrel-Sykes *Gear with a Backbone.* Backbone, the place where the teeth meet instead of being separated by a center groove, provides extra strength and load-carrying capacity. Other types of gears are furnished where required.

Bearings may be either babbitt-lined steel cartridges or any approved make of anti-friction bearing—always of adequate size for the job they have to do.

The precision ground shafts are designed to provide the rigidity necessary to prevent deflection and keep gears in exact alignment.

Dependent on conditions or requirements, lubrication may be by dip-and-splash system, by built-in pump driven by one of the shafts, or by a separate lubrication system.

Why not call on us when planning your next mill drive? Our engineers will be glad to discuss gear drive problems with you at any time without obligation.

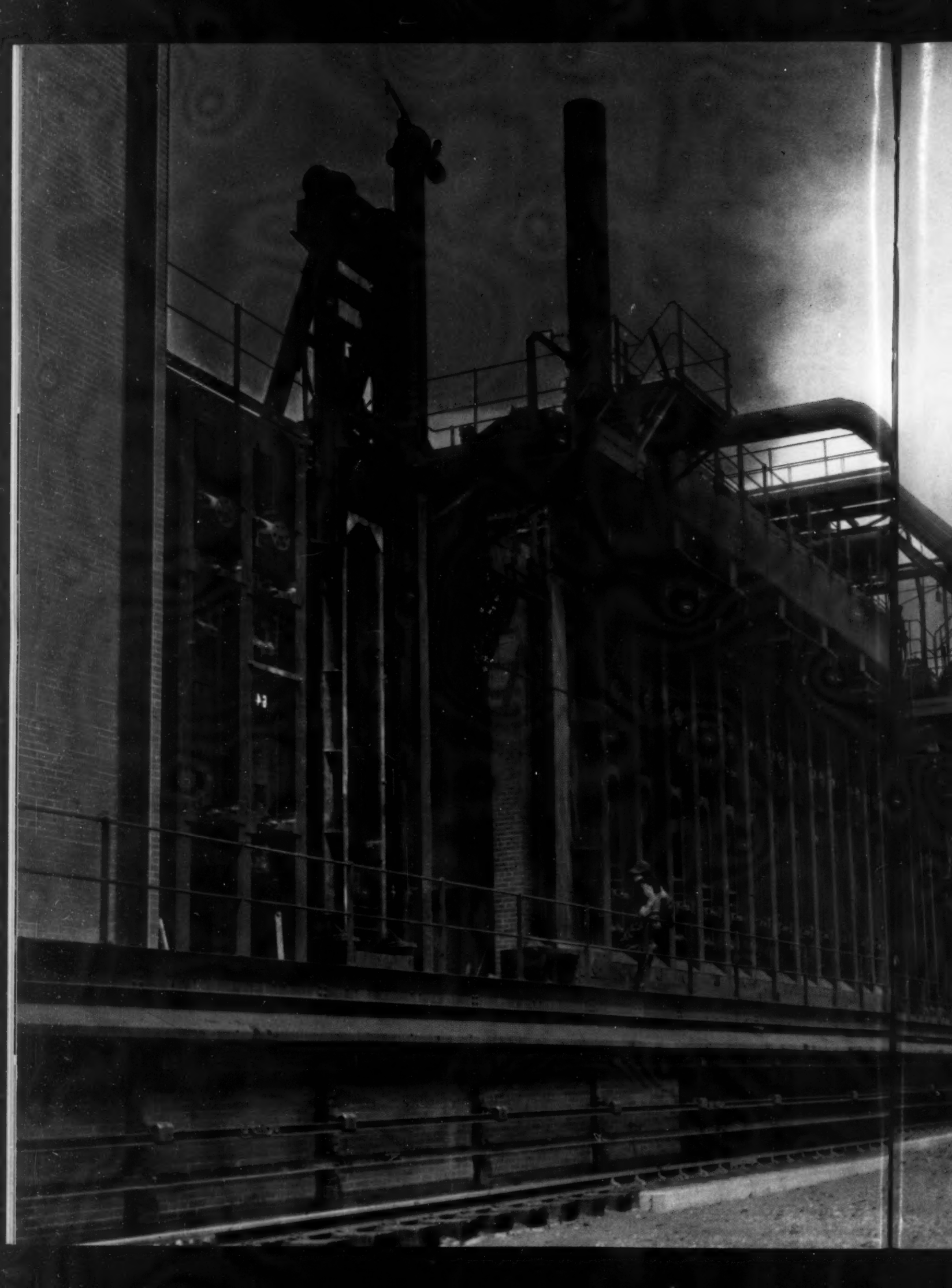
FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

Sales Offices: Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Chicago, Los Angeles, Tulsa, Houston

FB-421

Farrel-Birmingham



What does it take to build a good coke oven plant?

IT TAKES A GOOD BASIC DESIGN. We believe the Koppers-Becker Coke Ovens have the best of all designs . . . sturdy, free from complications, simple to control, with the largest practical coking capacity. This design can be used over a wide variety of conditions, making metallurgical or domestic coke with heating by any kind of fuel gas normally available, and in large or small sized ovens. The ovens are accessible throughout; this means low maintenance and long life.

IT TAKES CONSTANT ENGINEERING REFINEMENT. The number of coke oven plants which Koppers builds gives this company an unparalleled opportunity to develop new ideas to meet the new needs.

For example, the waste gas recirculation system was developed by Koppers to meet the need for greater coal carbonization capacity per oven. To produce more coke from ovens, it became necessary to make them greater in height. To get uniform heat in walls of very high ovens, when heating with coke oven gas, it was necessary to delay the rate of combustion. This has been accomplished with the waste gas recirculation system.

IT TAKES A FINE ENGINEERING STAFF. The Koppers engineering staff has proved its ability to design and erect the most advanced and efficient coal carbonization, material handling and gas treatment equipment.

KOPPERS COMPANY, INC. KOPPERS BUILDING, PITTSBURGH, PA.

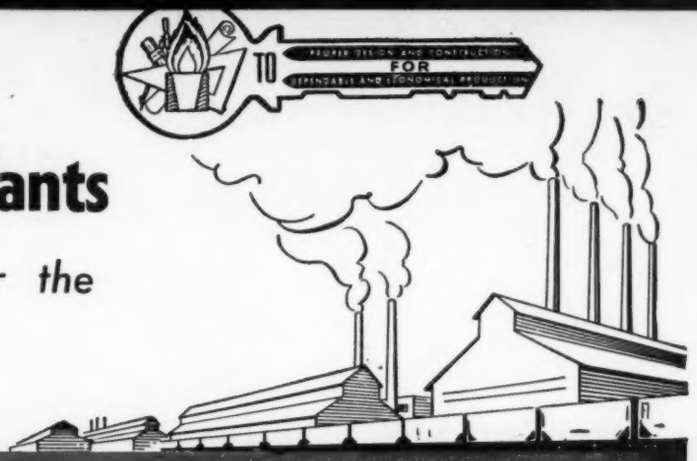
K
KOPPERS

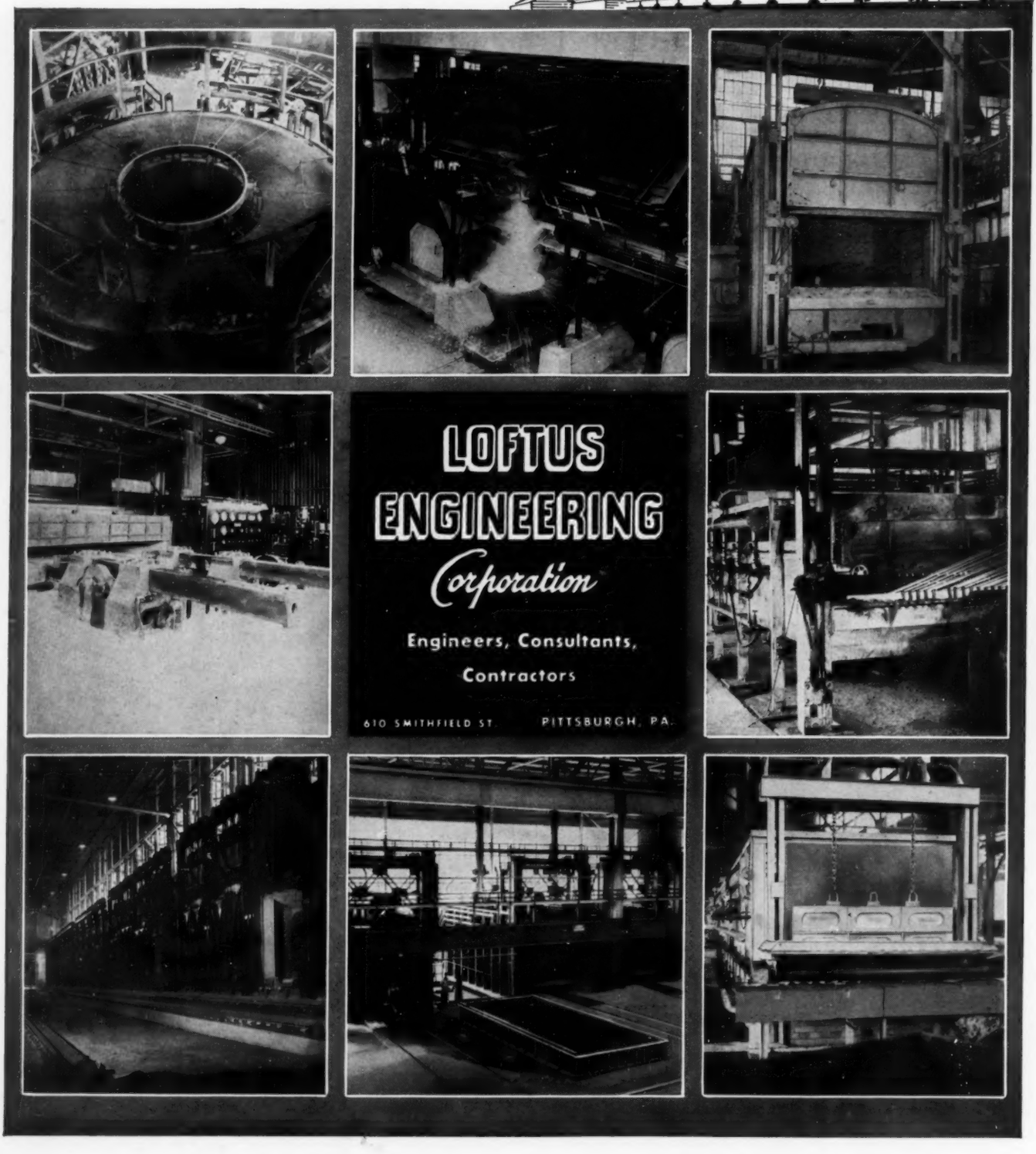
LOFTUS

Engineers Complete Plants

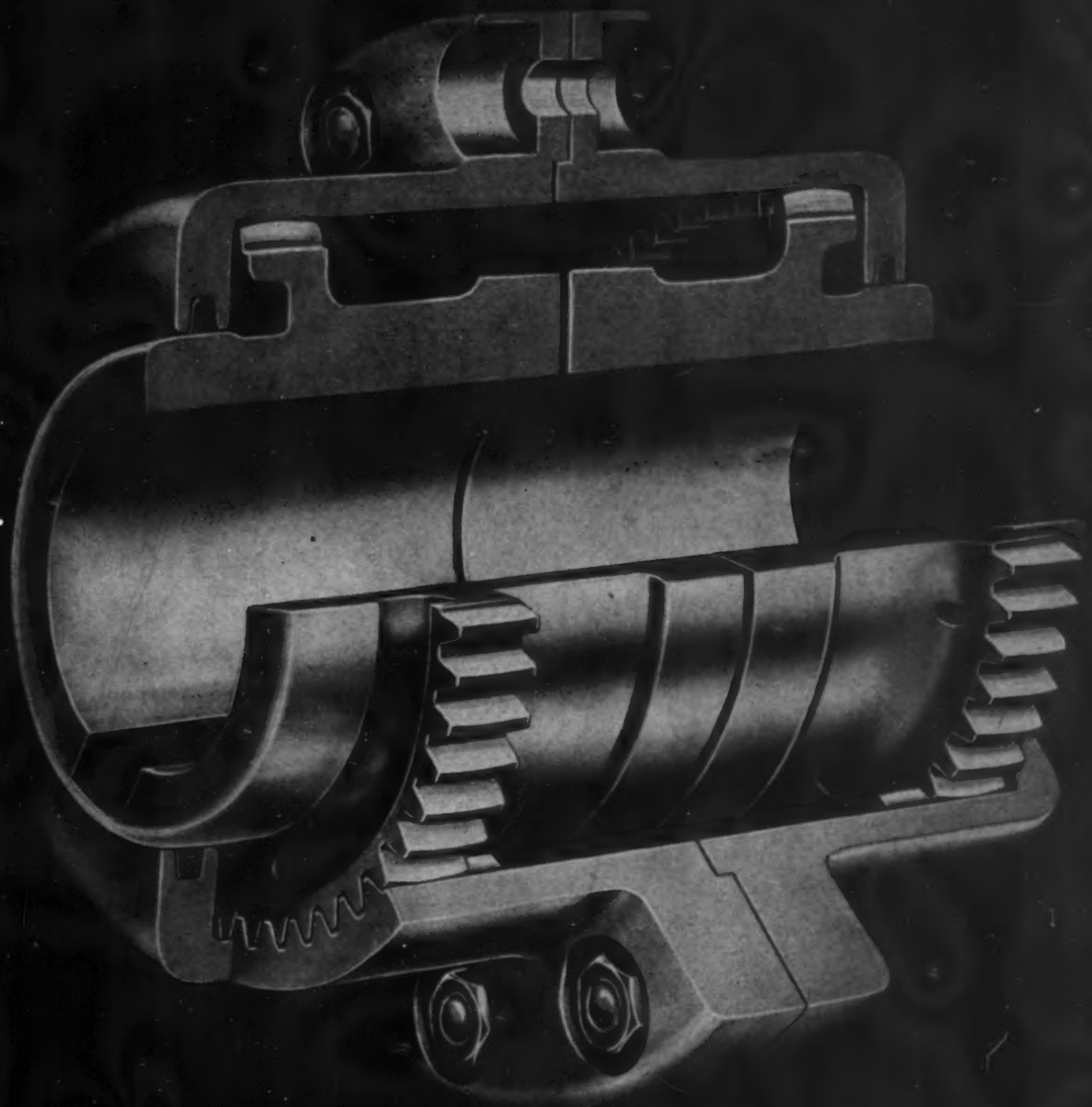
or *any* Component Part *for the*

MAKING OF STEEL





POOLE



A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

● The trend is strong toward use of carbon for blast furnace linings. Why? Just consider the valuable advantages of this basically different kind of lining material—

1 Lasts indefinitely!

A properly-installed carbon block lining in a blast furnace should last indefinitely. This results from the remarkable physical properties of carbon: no melting point, low thermal expansion, highly resistant to thermal shock, not wet by molten metals, immune to metal and slag attack, mechanical strength maintained at high temperatures.

2 No Salamander!

Years of experience with carbon linings bears this out. Consider what a saving this feature, alone, can mean to you.

3 Fast, easy to install!

One carbon block can take the place of from 50 to 1000 nine-inch firebrick, depending upon the size of the block. Overall installation time is thus greatly reduced.

Interior of hearth lining looking toward iron notch. Blocks may be of any size desired up to 24x30x180 in.

4 Economical in long run!

Operating experience is proving that carbon linings are definitely more economical in the long run . . . as is evident from the features outlined at left.

WHATEVER YOUR PROBLEM — CONSIDER CARBON OR GRAPHITE

Get more details:

Engineers at National Carbon Company, Inc., will be glad to supply you with full available information on all phases of installing a carbon lining. Write today to Dept. IS.

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UCC

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Division Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

Personnel News . . . .

James Darrow, general superintendent, Joliet works, American Steel and Wire Company retired September 30, after 52 years of continuous service with this U. S. Steel subsidiary. Mr. Darrow began his service with the wire company in 1896 as a carpenter apprentice with the construction crew at the company's present Waukegan wire mill. Appointed carpenter foreman a few years later, Mr. Darrow continued his move upward through mill supervisory positions becoming foreman of the galvanizing department, and foreman of wiredrawing. In 1924 he was made assistant general superintendent of Waukegan works.

In November 1936, Mr. Darrow came to Joliet works, as general superintendent, and subsequently handled the plant's modernization and construction program which resulted in its becoming the world's largest merchant products wire mill.

Richard R. Snow succeeds James Darrow as general superintendent of American Steel and Wire Company. Mr. Snow has been division superintendent of hot mills since his arrival at the Joliet plant in 1944. A native of Maine, he attended Colby college, U. S. Naval Academy, and holds a bachelor of science degree from Massachusetts Institute of Technology.

Robert B. Hastings is now superintendent of open hearth furnaces for Republic Steel Corporation's Warren district. Mr. Hastings has been with Republic for 17 years. A native of Ben Avon, Pennsylvania, he attended high school in that community and graduated from Muskingum College in 1925. He was employed for a period in the open hearth department of Wheeling Steel Corporation and went with Republic in 1930 as a first helper in the open hearth department. He was promoted to junior melter in 1941 and assistant open hearth superintendent in 1943.

Philip J. Bartholomew was made assistant superintendent of open hearths in the Warren district of Republic Steel Corporation. Mr. Bartholomew is a veteran of 30 years with Republic and its predecessor companies. A native of Trumbull county he attended school in Hubbard, Rayen High School in Youngstown and Hall's Business College. He was employed by Carnegie-Illinois Steel Corporation and Engel Aircraft Company during the first World War. In 1918 he went with Trumbull Steel as third helper in the open hearth department. He advanced to second helper in 1919, first helper in 1923 and junior melter in 1932. At the time of his current promotion he was a senior melter.

W. E. Brewster, general superintendent of the Wisconsin steel works, International Harvester Company, was appointed manager of operations for the steel division with headquarters in the general office at Chicago, Illinois. Mr. Brewster began his service at Wisconsin steel works in September, 1910. He was appointed blast furnace superintendent in April, 1928, and promoted to assistant general superintendent in August, 1936. Since July, 1945, he has been general superintendent of our steel plant. In his new position as manager of operations, Mr. Brewster will assume duties similar to those of the managers of manufacturing of other Harvester divisions. These new duties will embrace the operation of the steel plant, coal mines, steamships and interests in various iron ore projects.

R. A. Lindgren succeeds Mr. Brewster as general superintendent of the Wisconsin steel works of International Harvester Company. Mr. Lindgren started at the steel mill in August, 1923. He was promoted to blast furnace superintendent in August, 1936, and appointed assistant general superintendent in July, 1945.

F. M. Washburn was promoted from superintendent of metallurgy and inspection to assistant general superintendent for Wisconsin steel works of International Harvester Company. He began his steel mill service in September, 1919. He was promoted to assistant superintendent of the metallurgical and inspection department in 1933, and to superintendent of that department in April, 1945.

John H. Williamson has been made manager of industrial relations for Tennessee Coal, Iron and Railroad Company, Birmingham, Alabama. Mr. Williamson, an employee of TCI since October 1, 1925, moves up from the position of assistant manager of industrial relations.

C. H. Hunt, well known consulting engineer and head of the Pittsburgh technical organization, C. H. Hunt, Inc., and **Porter S. Kier,** comptroller of the Columbia Radiator Company, were elected directors of

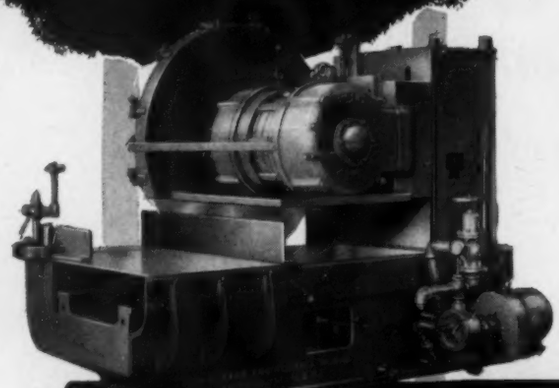
R. R. SNOW

ROBERT B. HASTINGS

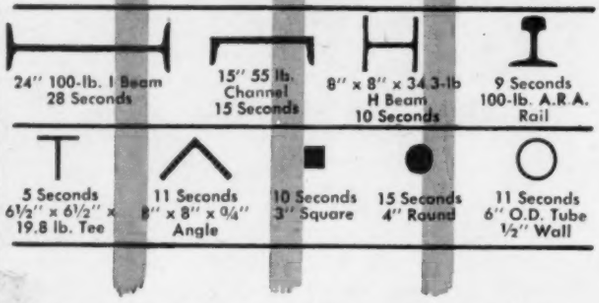
PHILIP J. BARTHOLOMEW

W. E. BREWSTER

Modern Sawing



with KLING HIGH SPEED FRICTION SAWS



Friction sawing is one of few mechanical processes which employ the heat of friction in a useful manner. It concentrates heat on the material to be severed at a rate which is faster than it can absorb heat. The immediate temperature rise of the contact surface is so great that its strength is reduced considerably lower than that of the colder blade rim. This heated surface is readily removed by the blade and permits complete severing of the material rapidly with no loss of metal from the blade.

Because of its versatile ability to cut many varied structural shapes, as well as solid or hollow bars in any sequence, without change of blade or set-up, one machine can handle a volume of cutting that would otherwise require several separate shears or slow speed saws.

Consult Kling engineers regarding your metal cutting problems. State size of material to be cut. Bulletin No. 9200 giving full particulars and suggestions as to the type and size of saw will be mailed promptly. No obligation.

KLING BROS. *Engineering Works*

Punches; Bar, Angle and Rotary Shears; Combination Shear, Punch and Copers; Plate and Angle Bending Rolls; Heavy Duty Grinders

1324 N. KOSTNER AVENUE, CHICAGO 51, ILLINOIS, U. S. A.

American Cladmetals Company at a recent board of directors meeting. Mr. Hunt and his staff are in charge of reconstruction and enlargement of the plant and strip rolling mills of the Steel Company of Canada, Ltd., at Hamilton, Ontario, and have had similar responsibility for the Kaiser Fontana plate mill and other major projects. Prior to forming his own organization ten years ago, Mr. Hunt was assistant to the president of the Weirton Steel Company, and consultant to Great Lakes Steel Corporation and Hanna Furnace Company, subsidiaries of the National Steel Corporation. Mr. Kier, besides his official relation to Columbia Radiator Company is the secretary and a director of the East Brady Fuel-Gas Company. He was for some years connected with the Pittsburgh Coal Company as director of budgets.

Brad C. Gamble has been promoted from superintendent of industrial relations to assistant to the general superintendent at Carnegie-Illinois Steel Corporation's sheet and tin mill at Gary, Indiana. Mr. Gamble started

BRAD C. GAMBLE

in the Gary sheet and tin mill April 7, 1919 as a laborer in the masonry department. In June of 1919 he was made labor foreman, he later became general foreman in the maintenance department. He has held his present position since May 22, 1939.

Paul J. Bowron, formerly assistant to manager of industrial relations, succeeds John H. Williamson as assistant manager of industrial relations of Tennessee Coal, Iron and Railroad Company, Birmingham, Alabama. Mr. Bowron, born February 8, 1905, in Birmingham, came to TCI as an instrument man in the engineering department of Fairfield steel works on May 23, 1928. Considerable service in various operations of Fairfield and Ensley works preceded his appointment as assistant superintendent of the annealing department at the Fairfield tin mill on August 1, 1937. He was promoted to annealing department superintendent July 1, 1942, and was appointed assistant to manager of industrial relations last November 16.

William P. Jones was,made superintendent of industrial relations at Carnegie-Illinois Steel Corporation's Gary sheet and tin mill, Gary, Indiana. Mr. Jones started his steel career at the Gary sheet and tin mill as an industrial engineer in November, 1936, but has been

THE world's largest builder of the world's largest cranes has developed many new Safety and Mechanical features now incorporated as standard practice in steel mill cranes. Replaceable bronze bearings . . . all-steel construction cranes including cast steel drums . . . a new system of reeving ropes for ladle cranes . . . these and many other features accepted as conventional today, were original with Alliance.

It will pay you to check with Alliance—for the development of new cranes or reconversion of old cranes to give your plants more lifting power. Rely on Alliance—for fifty-odd years the world's largest builder of the world's largest cranes.

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SPECIAL MILL MACHINERY · STRUCTURAL FABRICATION

Alliance

Since the days when Charlie Schwab signed orders for them, Smeeth-Harwood Hot Blast Valve Seats have been the recognized Standard of Dependability.

Today they are better than ever before—thanks to moulding and melting techniques developed and perfected thru the years.

Send your next order for Hot Blast Valve Seats to Smeeth-Harwood. The superior quality means longer, more dependable service at no extra cost.

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Superior* Blast Furnace Copper Castings *Exclusively.

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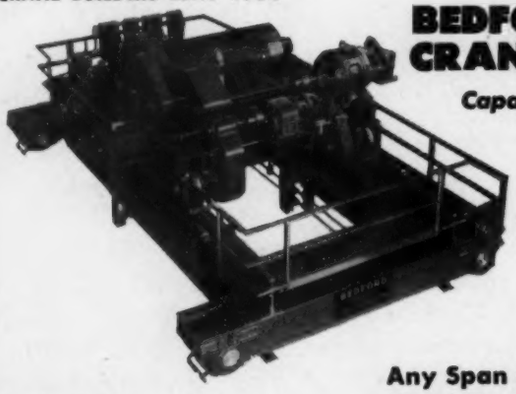

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BEDFORD FOUNDRY & MACHINE CO.

Engineers Designers Fabricators — **BEDFORD, INDIANA U. S. A.** — **Gray Iron Castings**

in the Pittsburgh, Pennsylvania, office of Carnegie-Illinois for the past three years. Before leaving for Pittsburgh, he served as assistant superintendent of industrial relations at the Gary sheet and tin mill. Mr. Jones has also worked at the Gary plant of American Bridge Company as an industrial engineer. He was born in Joliet, Illinois, and received his bachelor of science degree in aeronautical engineering at the University of Michigan.

J. Gerard O'Malley is now superintendent of the cold drawn bar mill at the Brier Hill plant of Youngstown Sheet and Tube Company, Youngstown, Ohio. Mr. O'Malley is a native of Scranton, Pennsylvania. After

J. GERARD O'MALLEY

graduating from high school there in 1930, he went to Rensselaer Polytechnic Institute at Troy, New York. Shortly after his graduation as a chemical engineer he joined American Steel and Wire Company at Worcester, Massachusetts, where he remained until he came to Youngstown.

W. H. "Pete" Williams, director and chairman of the board of Clark Controller Company, retired and resigned effective September 1. One of the founders of the company with the late P. C. Clark, he served 20 years as vice president in charge of sales, and moved

W. H. "PETE" WILLIAMS

successively to executive vice president, president, and chairman of the board. During all these years he built strong friendships throughout the steel and other heavy industries.

Charles W. Gerster has been appointed general manager of the Louthan Manufacturing Company, East Liverpool, Ohio. Mr. Gerster graduated from Ohio State University in 1930, with a degree of bachelor of

CHARLES W. GERSTER

ceramic engineering. Since that time he has been employed with Louthan in various capacities. Harbison-Walker Refractories Company recently purchased the Louthan Manufacturing Company.

Edwin R. Jung has been appointed manager of industrial sales for Clark Controller Company. A well known figure in the steel industry, Mr. Jung has spent many of his seventeen years with Clark as Atlantic coast regional manager. His new duties embrace application of Clark apparatus to steel and other heavy industries.

Paul J. Moore was appointed to the newly created position of director of sales and engineering for Crocker-Wheeler Electric Manufacturing Company. A graduate electrical engineer, Mr. Moore has been engaged in the engineering and selling of electric motors and generators for twenty-four years. Mr. Moore was formerly connected with the motor engineering and sales departments of General Electric Company, Schenectady, New York. He was subsequently sales manager of Imperial Electric Company, Akron, Ohio; manager of sales and engineering of Star Electric Motor Company, Bloomfield, New Jersey, and manager of the commercial department of Watson-Flagg Machine Company, Paterson, New Jersey. Mr. Moore attended both Massachusetts Institute of Technology and Syracuse University, graduating from Syracuse in 1923. This was followed by graduate work at Union College in Schenectady, New York.

Elmer F. Harris has been appointed assistant to the general superintendent of the Tennessee Coal, Iron and Railroad Company, Fairfield, Alabama. Mr. Harris, born September 27, 1906 at Clanton, Alabama, is a 1926 graduate of the University of Alabama, where he earned his bachelor of science degree in chemical engineering. He came to TCI July 12, 1926, as a chemist at Ensley works. After service in numerous assignments at Ensley and Fairfield, he was appointed assistant superintendent of the tin mill on September 1, 1945.

Clifford H. Bateman, Jr., was made assistant superintendent of the tin mill, Tennessee Coal, Iron and

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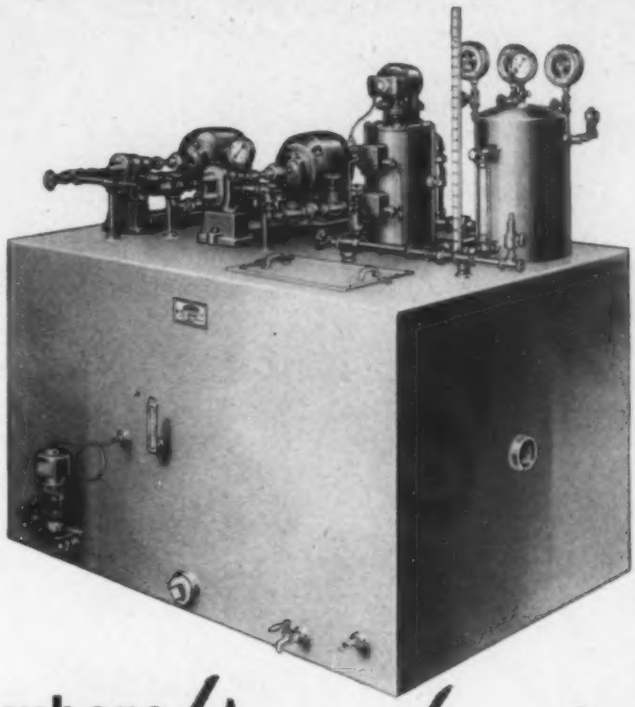
ESTABLISHED 1885
LUBRICATING SYSTEMS
FOR STEEL MILLS
and Other Industrial Plants



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Nearly a half century of specialized engineering and field experience is concentrated in a Bowser Lubricating System.

The flexibility of Bowser lubricating equipment permits exact adaptation to a great many different types of production machinery in steel mills, paper mills and other basic plants.

Observation of these installations through the years has conclusively established the dependability and efficiency of Bowser Lubricating Systems.

Bowser Engineers are at your service. You are invited to write, wire or telephone.

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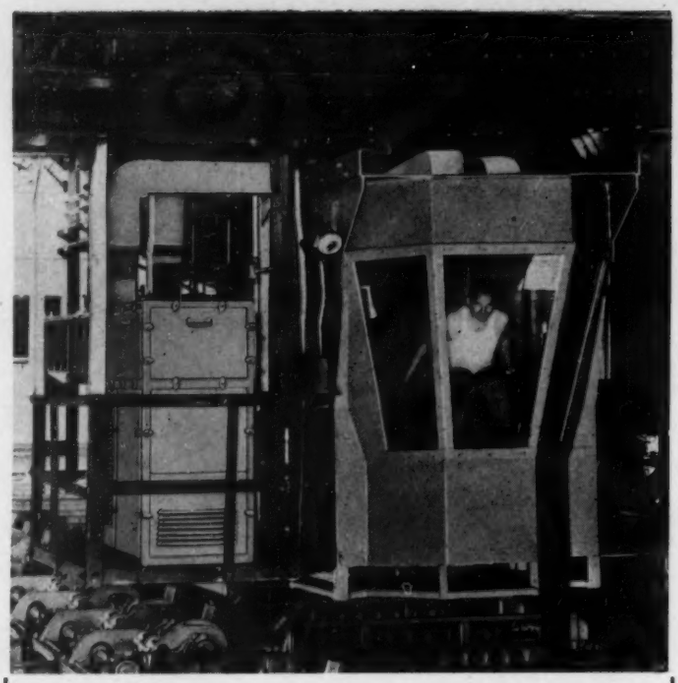

Soaking Pit Crane in plant of a prominent steel company, equipped with Lintern Aire-Rectifier 145 AC-24.

The Only Crane Cab Conditioner Thoroughly Tested on Soaking Pit Applications

The Lintern Aire-Rectifier, shown in the above illustration, is one of several in a large eastern steel plant.

After thoroughly testing the Aire-Rectifier on their soaking pit cranes, the company chose this unit for several other applications in the steel mill.

Lintern *balanced refrigeration* design prevents overloads in temperatures as high as 170 F. This is the only crane cab conditioner which has had thorough testing on soaking pit applications. It has been tried and has proven itself. Only periodic inspection is required. Over the years it has demonstrated its *low* maintenance.

Ask for Bulletin AC 82147.

THE LINTERN CORPORATION
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Glowlite Signals, Lanterns, Sanders, Shock Absorbers for Lamps, Ventilating Heaters, Aire-Rectifiers for Overhead Cranes.

Railroad Company, Fairfield, Alabama. Born July 27, 1914, in Franklin, Tennessee, Mr. Bateman attended Bethel College and Vanderbilt University, being graduated from the latter in 1937 with a bachelor of science degree in chemical engineering. He joined TCI as a student engineer June 16, 1937, later becoming a chemist at Fairfield steel works. He became metallurgical engineer, Fairfield sheet and tin mills, on October 1, 1945.

J. E. Hill became metallurgical engineer of the sheet and tin mill, Tennessee Coal, Iron and Railroad Company, Fairfield, Alabama. A native of Welch, West Virginia, where he was born May 31, 1912, Mr. Hill was graduated from Berea College in 1936 with a bachelor of science degree. He came to the research department at Ensley works on July 6, 1937. He was promoted to plant metallurgist at the tin mill on September 1, 1945.

S. S. Marshall, Jr., a director, member of the executive committee and vice president in charge of manufacturing operations for Jones and Laughlin Steel Corporation, has retired after 44 years' service.

J. B. Mitchell, who has been general manager of manufacturing operations of Jones and Laughlin Steel

J. B. MITCHELL

Corporation, has been elected a director, member of the executive committee and vice president in charge of operations.

E. K. Miller, who has been general superintendent

E. K. MILLER

HERE'S WHY...

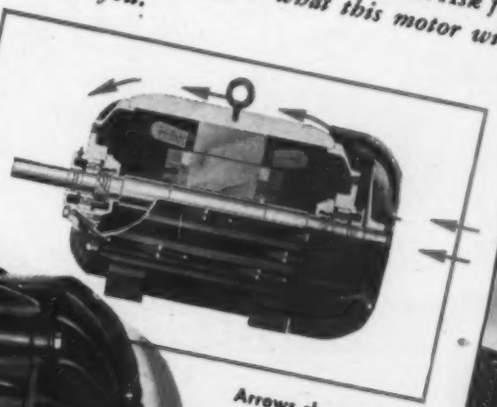
so many *Sealedpower* motors are being built today

More and more purchasers are specifying the Crocker-Wheeler Sealedpower Motor because they know it continues to operate year after year without "time out" for either cleaning or repairs. They know this motor doesn't have to be taken apart and cleaned periodically.

Crocker-Wheeler Engineers developed the Sealedpower Motor to permit continuous operation without shut-downs for the removal of dust and dirt from easily-clogged, hard-to-clean, double-walled passages found in conventional fan-cooled motors. The ventilating air that cools the Sealedpower Motor is always blown *outside* the frame, directed by heat radiating fins designed to properly guide and distribute the cooling air.

The vital operating parts are completely cut off from outside air. They run in a pocket of clean air, sealed in a frame of cast iron, immune to abrasive dust, corrosive fumes and excessive moisture.

The complete story of this exclusive Crocker-Wheeler design . . . the Sealedpower Motor . . . is contained in bulletin SL-300-2. Ask for your copy today. See what this motor will do for you.



Arrows show path of cooling air over exterior of frame.

CROCKER WHEELER

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QUALITY MOTORS AND GENERATORS SINCE 1888

The Best in Design Principle and in FOUNDRY PRACTICE

Graphically illustrated is an installation of the Kinney Refractory-Lined Tuyere Cooler, U. S. Pat. App. Serial 530,153. This advanced design lets the refractory bear the brunt of hot metal that may cut back through the tuyere and blow-pipe. It is equally important that flawless quality of the casting permits this efficient design to serve to fullest advantage. Falcon's maintenance of highest quality standards in its specialized service to the Steel Industry is your assurance of the best in foundry practice . . . on the Kinney Refractory-Lined Tuyere Cooler or any of your non-ferrous casting requirements. Remember, too, that Falcon specialized service means prompt delivery.

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YOUNGSTOWN 3, OHIO
Established 1890 • Incorporated 1895

Installed with the Kinney Refractory-Lined Tuyere Cooler (above) is the Holzworth "Split-Nose" Tuyere, U. S. Pat. 1,789,870, also in licensed production at Falcon.

★ FOR THE IRON & STEEL INDUSTRY ★

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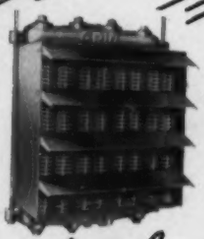
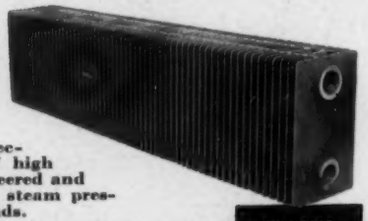
GRID UNIT HEATERS WILL LAST AS LONG AS THE PIPES FURNISHING STEAM TO THEM



GRID Unit Heaters will withstand high corrosive atmospheres; they are not affected by atmospheric conditions in steel mills, or dirt, dust, or particles in the air.

here's why



MAY BE INSTALLED HIGHER THAN OTHER UNITS

WITHSTANDS HIGH STEAM PRESSURES

FOR FOG REMOVAL

●One piece construction heating sections (patented) of high test cast iron engineered and tested to withstand steam pressures up to 250 pounds.

GRID condenser "fin" sections are made in one piece — no soldered, brazed, welded or expanded connections to become loose or develop leaks or breakdowns.

No electrolysis to cause corrosion, breakdowns, leaks, or heating failures, because there is only one type metal in contact with steam or hot water.

HIGH TEST CAST IRON HEATING SECTIONS

In many steel mills, foundries, etc., GRID Unit Heaters have been operating continuously for 17 years without maintenance. Ask for engineering data and complete details — also free booklet "Corrosion in Unit Heaters."

D. J. MURRAY MANUFACTURING CO.
WAUSAU WISCONSIN

of the Aliquippa works of the corporation, and **H. D. Stark,** who has been assistant general manager of manufacturing operations, have been appointed assistants to the vice president in charge of operations, Jones and Laughlin Steel Corporation.

H. F. Martin, who has been assistant general superintendent of the Aliquippa works of Jones and Laughlin

H. F. MARTIN

Steel Corporation, has been appointed general superintendent.

P. H. Devaney, who has been superintendent of hot rolling mills at Jones and Laughlin Steel Corporation's Aliquippa works, has been appointed assistant general superintendent.

V. H. Lawrence, a vice president of Jones and Laughlin Steel Corporation, has been elected a director and a member of the executive committee.

C. M. Murray was appointed exclusive Canadian representative in the provinces of Ontario and Quebec for Poole Foundry and Machine Company. Mr. Murray's headquarters will be in the Foy Building, Toronto, Ontario.

Ernest W. Polley has been appointed assistant chief chemist for the Youngstown district of Youngstown Sheet and Tube Company. He succeeds **L. C. Flickinger** who recently was appointed chief chemist following the death of **D. A. Russell.** Mr. Polley, a native of the Youngstown district, graduated from Carnegie Institute of Technology as a chemical engineer and worked for a year with Hazel Atlas Glass Company at Wheeling, West Virginia, before coming to the Brier Hill plant as a chemist in 1928. Two years later he was transferred to the Campbell plant as a chemist and in 1935 returned to Brier Hill as general foreman in charge of the chemical department.

H. A. Glover has been appointed assistant sales manager for S & C Electric Company (formerly Schweitzer and Conrad, Inc., Chicago, Illinois.). Mr. Glover was graduated in 1932 from Carnegie Institute of Technology, Pittsburgh, and for a number of years was occupied in the same city with various electrical engineering duties with West Penn Power Company, Duquesne Light Company, and Carnegie-Illinois Steel Corporation. Later, while in the sales department of the I-T-E Circuit Breaker Company, Philadelphia, his business career was interrupted by three years' service overseas in the United States Navy. He joined S & C Electric Company as sales department supervisor in the fall of 1946.

NON-FLUID OIL

TRADE MARK REGISTERED

Meets every requirement of pressure lubrication

Next time ordinary grease clogs your centralized lubrication system, change to NON-FLUID OIL and notice the difference. NON-FLUID OIL meets every requirement of pressure lubrication because it stays "alive longer" . . . can't dry out and won't separate under pressure. What's more, it contains nothing of a residual nature that would clog fittings and allow bearings to run dry. For a longer-lasting lubricant that cuts down lubrication and application costs . . . specify NON-FLUID OIL.

WORKS: Newark, N. J. - WAREHOUSES: Atlanta, Ga. - Greenville, S. C. - Charlotte, N. C. - Providence, R. I. - Chicago, Ill. - St. Louis, Mo. - Detroit, Mich.

Current Quote "Before using NON-FLUID OIL, we had at least one or two ball bearings go bad every week, but since using NON-FLUID OIL in all ball bearings, we haven't had one go bad in a year."

NEW YORK & NEW JERSEY LUBRICANT CO.

292 MADISON AVENUE, NEW YORK 17, N.Y.

N. Y. & N. J. LUBRICANT CO., Dept. 1S
292 Madison Avenue, New York 17, N. Y.
Please send me testing sample of NON-FLUID OIL to be used in the following machinery:

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"SAFETY" HEAVY BEVEL STAMPS

Here are the most widely known and most practical stamps for all marking purposes. Made of MECCO alloy steels which eliminate dangerous spalling and mushrooming — in character sizes from $\frac{1}{32}$" up. Impressions are deep and clear cut.

- NO SPALLING
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- 25% TO 50% MORE SERVICE
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Eliminate HARD COMBUSTION DEPOSIT *and* SLAG

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GAMLENITE

METAL REPLACEMENT

BEFORE GAMLENITE TREATMENT

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GAMLENITE is a unique dry powder that is blown into the furnace while it is operating. It reduces corrosive combustion deposits and hard slag to a fluffy powder, which is normally carried out the stack by the draft.

Gamlenite reaches spots inaccessible to hand cleaning, which it practically eliminates. It assures efficient heat transfer, lengthens life of tubes* and refractories, keeps boilers on the line. It is safe, non-explosive, can be used in all types of boilers. Send for Bulletin 454.

*Gamlenizing boiler metal surfaces makes them corrosion-proof, protecting against destructive action of acids in the combustion deposit, and greatly reducing the adherence of future deposit. Only Gamlenite has this feature.

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Steam . . . water . . . oil . . . or gas
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. . . A good thing to remember for a simplified piping job every time . . . on new or replacement installations. No matter what the fluid or working conditions, see the Crane line first for *all* piping equipment . . . and for dependable quality in every item.

For this water supply system, for example, the Crane Catalog puts everything at your finger tips . . . valves, fittings, pipe, and pipe line accessories. One order to your Crane Branch or Wholesaler covers all your needs. From design to erection to maintenance, your piping job moves fast and smooth . . . with good performance assured . . . because you get this 3-way advantage:

ONE SOURCE OF SUPPLY offering the world's largest selection of steel, iron, brass and alloy piping materials for all power, process, and general service applications.

ONE RESPONSIBILITY for piping materials—helping you to get the best installation, and to avoid needless delays on the job.

OUTSTANDING QUALITY in every item—assuring uniform dependability and durability throughout piping systems.

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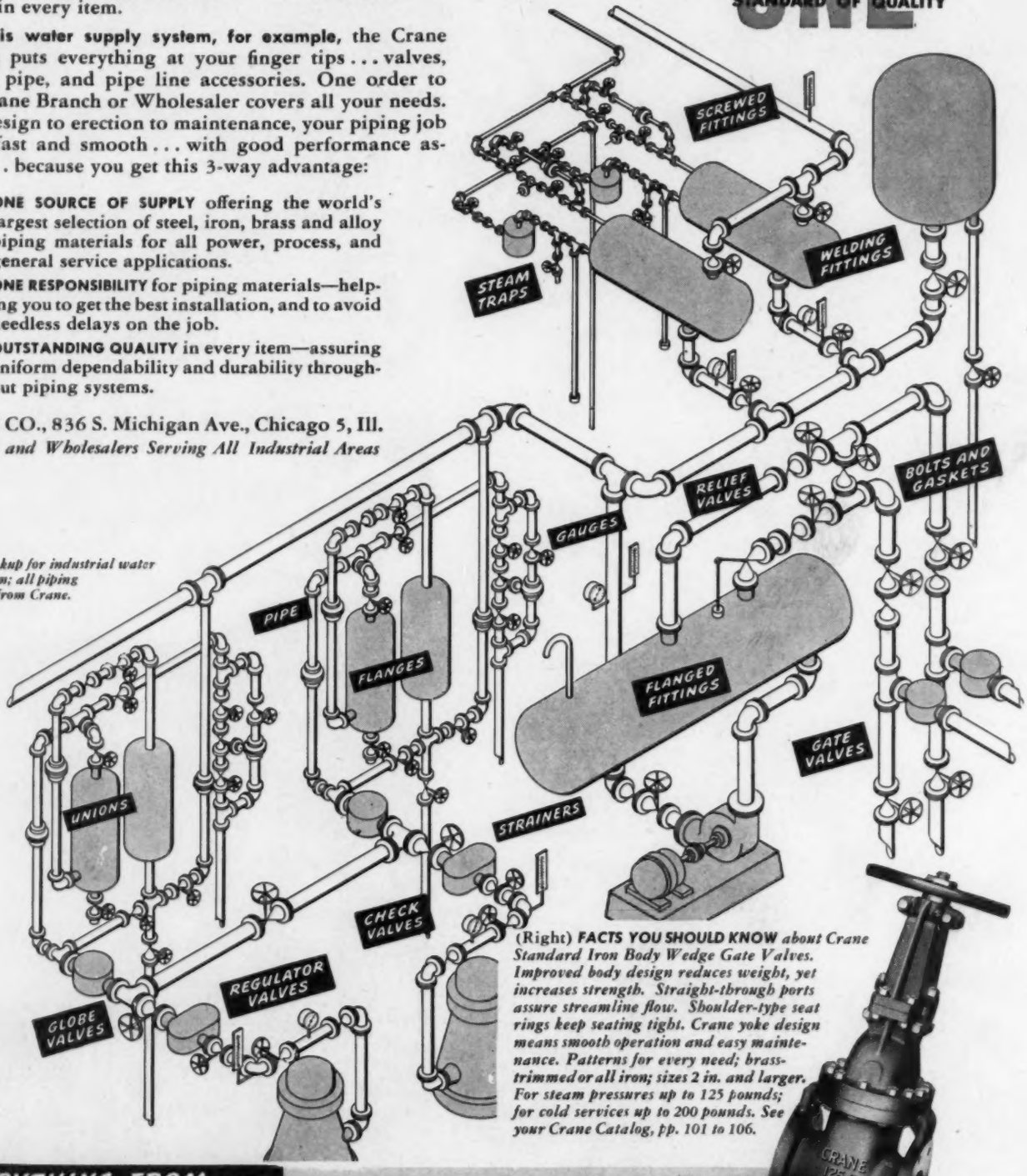


Typical hookup for industrial water supply system; all piping equipment from Crane.

(Right) **FACTS YOU SHOULD KNOW** *about Crane Standard Iron Body Wedge Gate Valves. Improved body design reduces weight, yet increases strength. Straight-through ports assure streamline flow. Shoulder-type seat rings keep seating tight. Crane yoke design means smooth operation and easy maintenance. Patterns for every need; brass-trimmed or all iron; sizes 2 in. and larger. For steam pressures up to 125 pounds; for cold services up to 200 pounds. See your Crane Catalog, pp. 101 to 106.*

EVERYTHING FROM . . .

CRANE

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

FOR EVERY PIPING SYSTEM

the BILLETEER cuts conditioning costs 4 ways

$ LOWER LABOR COSTS

One semi-skilled operator, using a Billeteer, can do the work of ten hand chippers —radically reducing labor cost and releasing man-power for less-killing, actually-productive work.

$ SUSTAINED EFFICIENCY

Operation of the Billeteer imposes no strains on the worker. Quality and quantity of output never suffer from fatigue, grogginess, jitters, illness or "off" days.

$ VALUABLE SCRAP RECOVERY

The Billeteer does not "burn up" hard-to-get scrap. Every chip can be saved . . . clean . . . classified according to analysis . . . ready for the charging box. In some mills, each Billeteer saves as much as 1½ tons of scrap a day.

$ BILLET SALVAGE

Because of the low operating cost, the Billeteer can be used to salvage billets so badly seamed that it would be impractical to attempt to save them without the Billeteer.

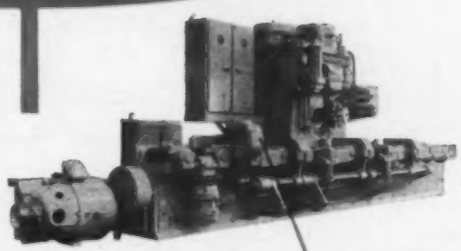
LET US SHOW YOU how much the Billeteer can save in your Billetshed operations.

Engineered

FOR LOWER OPERATING COSTS

BONNOT

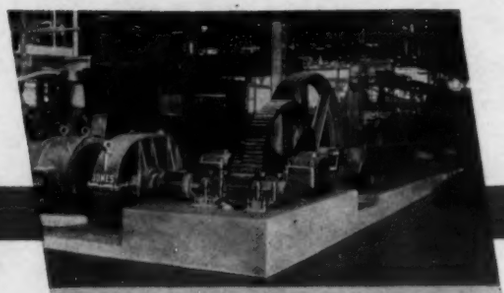
THE BONNOT COMPANY • builders of the BILLETEER • CANTON 2, OHIO



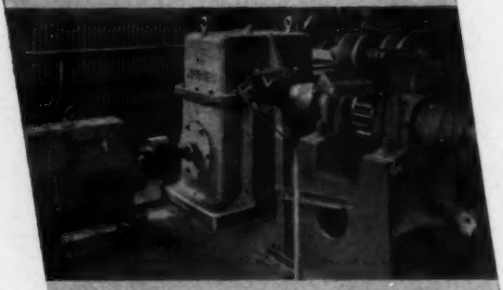
• Bonnot Billet Inspection Tables • Charging Tables • Cold Saws Grinding Pans • Clay Mixers • Clay Feeders, Etc. •

KEEP GOING

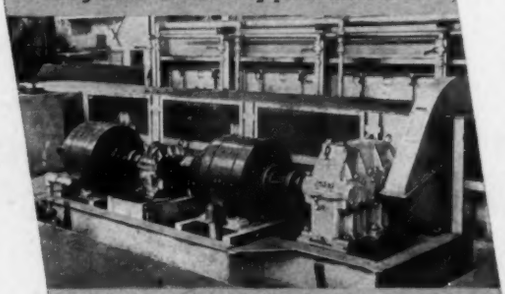
. . . WITH JONES



Jones Herringbone Speed Reducer driving steel tube mill draw bench. Gear casings removed to show proportions of spur gear drive to head shaft.



Jones Worm Gear Speed Reducer operating cover of warming pit in steel mill.



Jones Herringbone Reducers operating furnace in steel mill. Drive consists of two motors with single type and double type reducers coupled in series in order to obtain two widely varying speeds.

Two of a battery of 10 Jones Worm Gear Door Hoists for operating open hearth furnace doors.

Jones Herringbone Reducer operating sheet mill tilting drive on feeder table.

• In every phase of the steel business today, whether it is production or fabrication, the cry is "keep going".

The Jones organization, too, is busy manufacturing the various types of speed reducers and other transmission products that are so essential for drives in every type of plant — drives that are so necessary in maintaining peak production.

We picture here some typical Jones drives that have seen years of service in the steel industry. They have been called upon to take a lot of punishment and they will stand the gaff for a good many years to come.

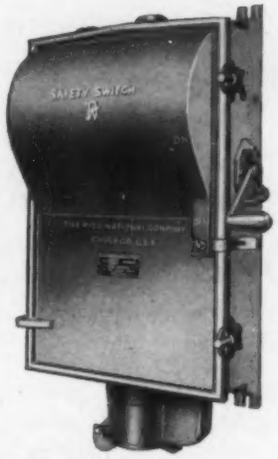
W. A. JONES FOUNDRY & MACHINE COMPANY
4431 Roosevelt Road, Chicago 24, Illinois

Jones

HERRINGBONE — WORM — SPUR — GEAR SPEED REDUCERS • PULLEYS • GEARS • V-BELT SHEAVES • ANTI-FRICTION PILLOW BLOCKS • FRICTION CLUTCHES • FLEXIBLE COUPLINGS

Heavy-duty Safety Switches & Circuit Breaker Pylets

Circuit breaker Pylet with interlocked receptacle and QuelArc plug.



Safety Switches: 2, 3, and 4 pole; 30, 60, 100 and 200 amperes; 125, 250 and 600 volts; fusible type; with or without interlocked receptacle for QuelArc plug.

These Pyle-National safety switches are built for mill and railroad service, with the substantial construction needed to withstand severe operating conditions. Case and cover are heavy-section galvanized cast iron; operating parts are heavy cast metal, and designed for quick make and break action. Contacts are mounted on heavy slate. The operating shaft has bronze bearings. The case is fully protected, with both cover and hub plates equipped with weatherproof gaskets. The operating lever extends through the case in a rust-proof bearing and the cover is held closed by rust-proof wing nuts and bolts. These features assure dependable service and long life even under severe operating conditions.

Circuit breaker Pylets of similar heavy duty construction are available with or without interlocking receptacle for QuelArc plugs.

Consult your Pylet catalog for complete listings or write for recommendations.

THE PYLE-NATIONAL COMPANY
1334-58 North Kostner Avenue • Chicago 51, Illinois

Offices: New York • Baltimore • Cleveland • Pittsburgh
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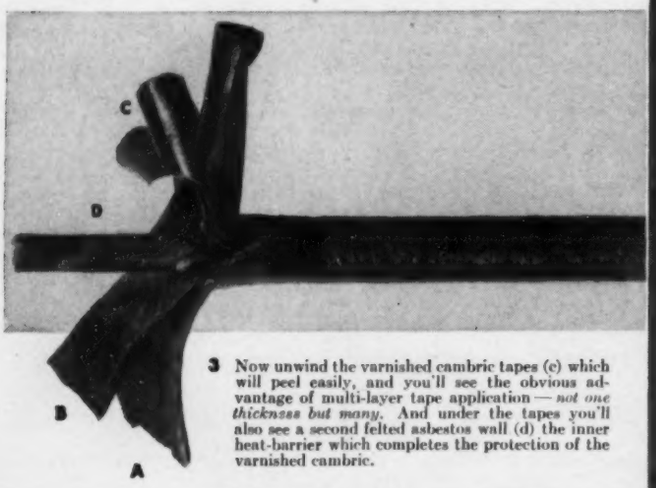
ELECTRICAL EQUIPMENT
• SINCE 1897 •

CONDUIT FITTINGS • FLOODLIGHT PROJECTORS • LOCOMOTIVE ELECTRICAL EQUIPMENT

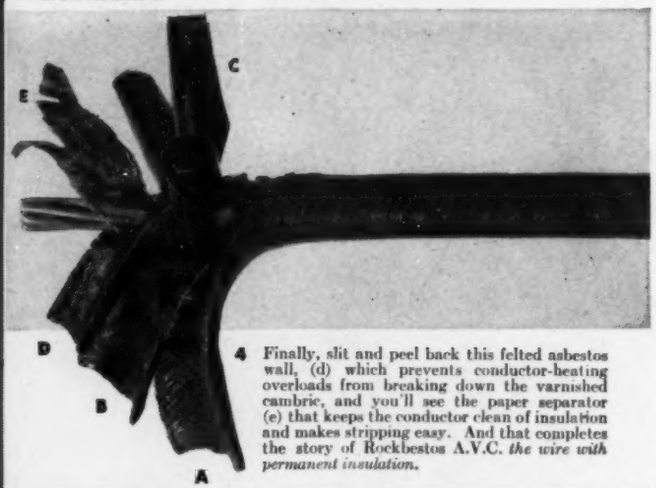
For Resistance to Heat and Fumes LOOK Beneath the Braid

1 Take a sample of Rockbestos A.V.C. Power Cable, illustrated, or similarly insulated Motor Lead Cable, slit open the heavy asbestos braid (a) which is resistant to heat, flame, moisture, oil, and grease, and you'll find beneath a firewall of felted asbestos (b) a permanent heat-barrier against high ambient temperatures.

2 Then cut through this felted asbestos wall (b) peel it back, and see the high-dielectric moisture-resistant varnished cambric tape (c) it protects from heat, flame and oxidation. Notice, too, the uniform coverage of the tapes, helically applied like the felted asbestos to assure perfect and permanent centering of the conductor in the insulation.



3 Now unwind the varnished cambric tapes (c) which will peel easily, and you'll see the obvious advantage of multi-layer tape application — *not one thickness but many.* And under the tapes you'll also see a second felted asbestos wall (d) the inner heat-barrier which completes the protection of the varnished cambric.



4 Finally, slit and peel back this felted asbestos wall, (d) which prevents conductor-heating overloads from breaking down the varnished cambric, and you'll see the paper separator (e) that keeps the conductor clean of insulation and makes stripping easy. And that completes the story of Rockbestos A.V.C. *the wire with permanent insulation.*

A casual inspection isn't enough when it comes to selecting wire and cable for performance in hot-spot service. You've got to look *beneath* the braid! When circuits must operate next to boilers, furnaces, steam lines, drying ovens, resistor grids and soaking pits it is vitally important that the wire is *completely* insulated to withstand heat and moisture, corrosive fumes, oil, grease and flame.

The photos and text above tell the "inside story" of the reasons why Rockbestos A.V.C. Power, Motor Lead and Lighting Wires and Cables (National Electrical Code, Type AVA) will protect circuits and reduce maintenance . . . why their *permanent insulation* makes possible *continuous operation* at 230° F., under varied severe conditions without baking brittle, flowing or rotting.

Send for a sample, look beneath the braid, and see for yourself why Rockbestos A.V.C. gives more service per foot in the worst places. Several types for power, lighting and control circuits, switchboards and equipment, in 600 to 5,000 volt ratings. Just ask for what you are interested in. Write to:

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ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

125 different permanently insulated wires, cables and cords

developed by Rockbestos for various severe operating conditions

NEW YORK BUFFALO CLEVELAND DETROIT
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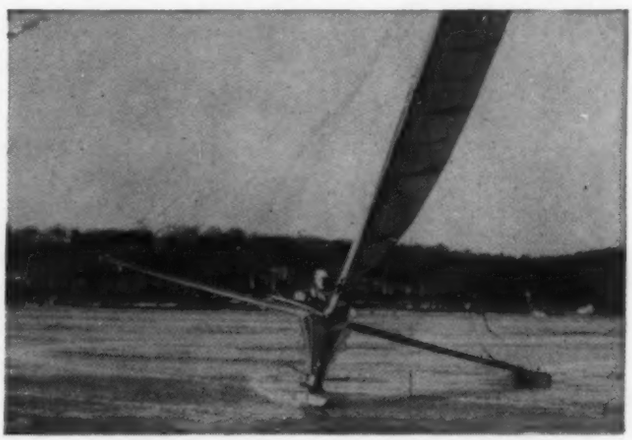
How is production stepped-up with

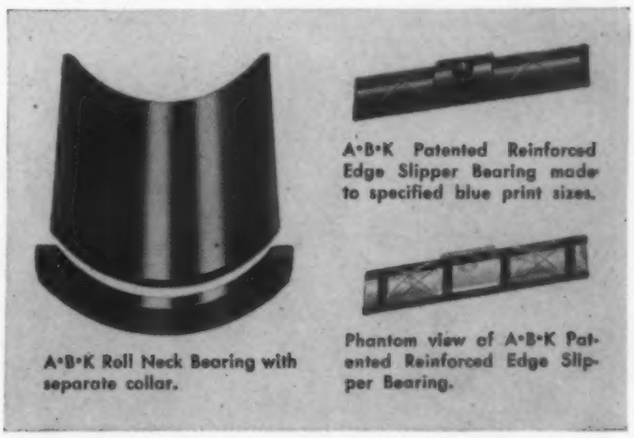
LAMINATED PLASTIC BEARINGS?*

1 **Records kept** by many steel mills show conclusively that production goes up when laminated plastic bearings replace metallic bearings. Why? There are fewer shut-downs for bearing replacement, more productive hours per mill, because . . .

2 **These extremely** durable bearings customarily outwear metal bearings by several times. This means, too, that close tolerances are held with a bare minimum of roll adjustments. Time usually lost is saved. Another important point to you is this . . .



3 **The hard, smooth** surface of laminated plastic bearings has a very low coefficient of friction. Here are substantial power savings and also big savings in grease and oil, as *water* is successfully used for lubrication. For all these outstanding reasons . . .


A·B·K Patented Reinforced Edge Slipper Bearing made to specified blue print sizes.
A·B·K Roll Neck Bearing with separate collar.
Phantom view of A·B·K Patented Reinforced Edge Slipper Bearing.

4 **Always specify** A·B·K Laminated Plastic Bearings. The engineering, research and production facilities of American Brakeblok stand behind these bearings. A test will show how A·B·K Laminated Plastic Bearings up production and cut costs.

5 For full information on A·B·K Laminated Plastic Bearings and their application to your steel mill bearing problems, communicate with American Brakeblok Division, 4600 Merritt Avenue, Detroit 9, Michigan.

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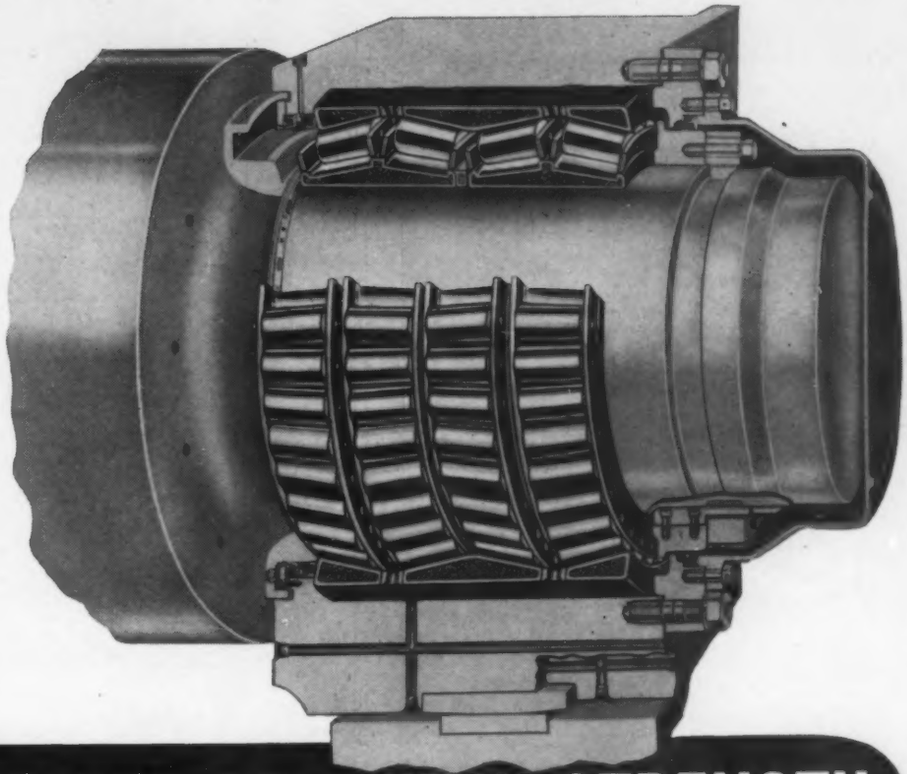
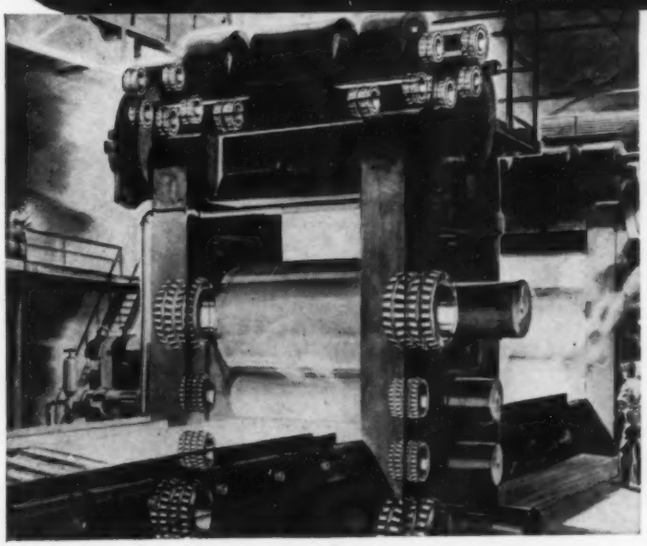
Timken balanced proportion Roll neck bearings assure...



50%-60% GREATER ROLL NECK STRENGTH



...with the help of NICKEL ALLOY STEEL

The cut-away view shows you a rolling mill bearing that provides peak performance plus long term endurance.

In addition to making possible larger, stronger mill roll necks, Timken Balanced Proportion Bearings show load ratings ranging up to 40% higher than in previous designs of tapered roller bearings.

Produced from a modified Type 3312 Nickel-chromium steel, Timken Roll Neck Bearings not only reduce starting and operating friction, but also withstand heavy shock loads because the Nickel alloy steel rollers and races have a high degree of hardness in the case, together with an exceptionally tough, strong core.

Experience proves that it pays to use Nickel alloyed steels for heavy-duty service. Nickel and its alloys may help to improve your products or equipment. Send us details of your problems for our recommendations. Write today.

EMBLEM OF INCO SERVICE
TRADE MARK

Over the years, International Nickel has accumulated a fund of useful information on the selection, fabrication, treatment and performance of engineering alloy steels, stainless steels, cast irons, copper-base and other alloys containing Nickel. This information is yours for the asking. Write for "List A" of available publications.

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Investigate and you will find why manufacturers are standardizing on

LINCOLN

Single Line

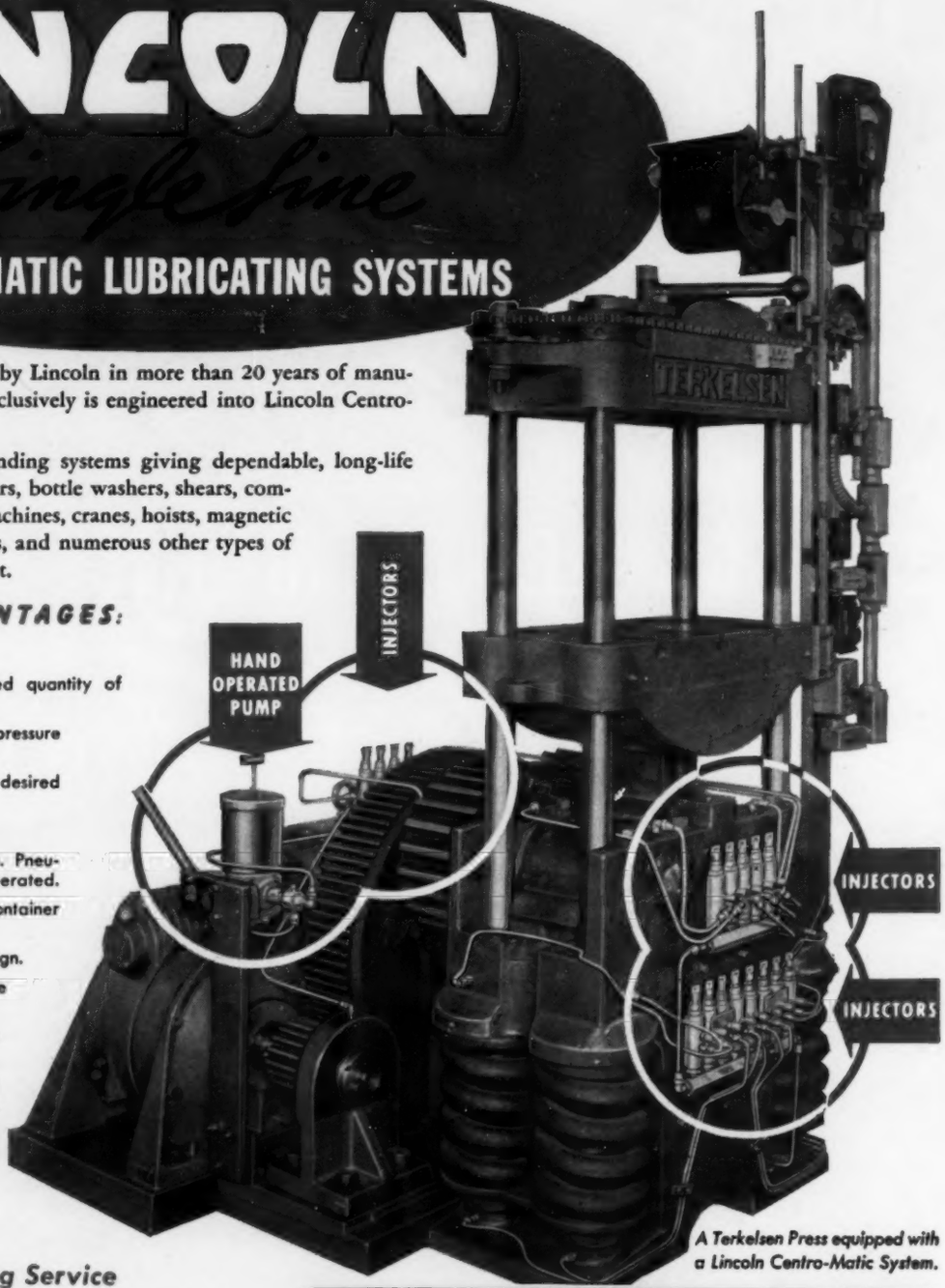
CENTRO-MATIC LUBRICATING SYSTEMS

The Specialized Experience gained by Lincoln in more than 20 years of manufacturing lubricating equipment exclusively is engineered into Lincoln Centro-Matic Lubricating Systems.

Today, you will find these outstanding systems giving dependable, long-life service on punch presses, duplicators, bottle washers, shears, compression molders, candy making machines, cranes, hoists, magnetic separators, spacers, printing presses, and numerous other types of industrial machinery and equipment.

CHECK THESE ADVANTAGES:

1. Dispenses either oil or grease.
2. Delivers a pre-determined measured quantity of lubricant to each bearing.
3. Lubricant delivered at a uniform pressure even to remote bearings.
4. Injectors are easily adjusted for the desired output—no special tools needed.
5. Each injector has external indicator.
6. Complete range of lubricant pumps. Pneumatically, electrically or manually operated.
7. Will pump lubricant from original container at fixed time intervals.
8. All pumping units are of proven design.
9. One pump can supply one machine or a battery of machines.
10. Easy to install. Only one supply line needed.
11. Injectors in manifold can be removed singly without disturbing other injectors.
12. Linpak packing—no metal-to-metal seals.
13. A product of a company that manufactures lubricating equipment exclusively.



A Terkelsen Press equipped with a Lincoln Centro-Matic System.

Engineering Service

To assist you in determining the Lincoln system best suited to the machine tools you are manufacturing, the services of trained Lincoln Lubricating Engineers are available on request.

LINCOLN

Pioneer Builders of Engineered Lubricating Equipment

Lincoln Engineering Company, St. Louis 20, Mo.

Please send me illustrated literature on Lincoln Centro-Matic Systems.

*Name*_____

*Title*_____

*Company*_____

*Address*_____

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ISE 9447

What's the Story on Oxygen in Steel-Making Furnaces? No. 2 of a Series (No. 1 was a general review)

The LINDE Jet Device inserted through door of the open-hearth furnace.

Oxygen at supersonic velocity is being injected through the LINDE Jet Device into the molten bath during decarburization.

OXYGEN
Speeds Decarburization

THE GREATEST AMOUNT OF EXPERIMENTAL WORK on use of oxygen in the steel-making furnace has been directed toward shortening the refining period. Data on oxygen* use in more than 6,500 heats in 34 mills with which LINDE has co-operated have been recorded. Among these data are records of tests in which oxygen of various purities, compressed air, and even nitrogen, were injected into the molten bath.

All these tests produced rates of decarburization better than are obtained through normal ore practice. The effectiveness was greater, however, the higher the oxygen purity. With high-purity oxygen, rates of carbon reduction were increased two to four times over normal rates. Both the lance and Jet Device were used to introduce the oxygen.

Before final acceptance is assured, the equipment for injecting oxygen must be mechanized. The LINDE Jet Device, a water-cooled non-consumable tool, seems at present to offer the best opportunity for mechanization that will eliminate interference with charging procedures.

Much more extensive experience in individual shops must be gained before the optimum oxygen purity for use in each phase of steel-making can be determined.

*Supplied mostly as DRIOX high-purity liquid oxygen. Economics of low-purity gaseous oxygen will depend on purity, quantity, pressure required; size of storage facilities; and other demand characteristics.

Management and production executives are invited to write for the factual report which LINDE *has prepared on oxygen use in steel-making furnaces. Please address Room 308, 30 E. 42nd St., New York 17, N. Y.*

Linde
Trade-Mark

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities
In Canada: DOMINION OXYGEN COMPANY, LIMITED, Toronto

The words "Linde" and "Driox" are registered trade-marks of The Linde Air Products Company.

FOR CONTINUOUS AUTOMATIC PROPORTIONING WITH *Maximum Accuracy*..

THE ASKANIA RATIO REGULATOR

A simple, accurate way of mixing two or more liquids or gases to a predetermined ratio. Ratio can be changed easily without interruption of the process. • The Askania Ratio Regulator has only a few moving parts reducing maintenance to a minimum. • Low pressure systems use Fiberglas Diaphragms, measuring changes in conditions as small as .0025" W.C. • Turn down range of 10 to 1, with accuracy across full range. For control of fuel/air mixtures, for mixing propane-butane and natural gas, for processing change from batch to continuous mixing...for proportioning two or more gases, liquids or gases with liquids...use the Askania Ratio Regulator.

for detailed data get Technical Bulletin No. 101

OTHER ASKANIA EQUIPMENT AVAILABLE FOR THE ACCURATE CONTROL OF FLOW, PRESSURE, SPEED AND CONSISTENCY

ASKANIA Controls

ASKANIA REGULATOR COMPANY

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION
240 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS

EXPORT OFFICE FOR LATIN AMERICA: 44 WHITEHALL ST., NEW YORK, N. Y.

PICTURE QUIZ: Which of these five people gives the right reason for buying U.S. Bonds?

(ANSWER BELOW)

1. Easy to save! "I'm putting my money into U. S. Bonds because it's the *easiest way* for me to save. Under the Payroll Savings Plan, I put aside a regular amount each week for Bonds. So far, I've saved $500 without missing the money!"

2. Good investment! "Getting back $4 for every $3 I invest—the way I will in ten years' time with U. S. Bonds—is my idea of a *good investment*. I know it's safe and sound, too, because it's backed by Uncle Sam. Buy Bonds, I say."

3. Plans for the future! "Ten years from now, the money I'll get for my U.S. Bonds will help to send my kids to college, or buy our family a new home. I think that buying U. S. Bonds is the wisest thing a family man can do."

4. Fights inflation! "I want America to stay economically sound. That's why I'm putting all our extra dollars into U. S. Bonds. It's like buying a share in our country's future prosperity!"

5. Rainy day! "Maybe a rainy day's coming for me. Maybe it isn't. But I am taking no chances. That's why I'm buying all the U. S. Bonds I can through my Payroll Savings Plan."

THE ANSWER

Every one of these people gives the "right" reason—because there's more than one right reason for buying U. S. Bonds.

Whichever way you buy them—through Payroll Savings, or your local bank or post office—U.S. Bonds are the best investment you can make!

Save the easy way..buy your bonds through payroll savings

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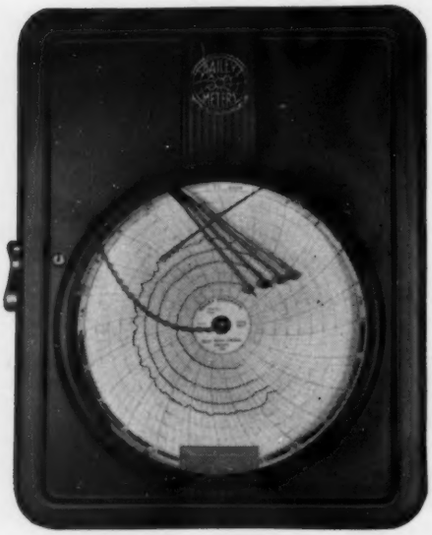
Trick Arithmetic?



Bailey Electronic Recorder

NOT AT ALL. It's an equation instrument users are applying to simplify meter and control installations. It's an equation worth remembering.

Here's how it works:

The Bailey Meter Company has simplified electronic instruments and controls to 4 basic circuits and 8 basic component parts. With these 4 circuits and 8 parts you can get more than 100,000 combinations of electronic instruments and controls.

Here's what happens when you specify Bailey Controls. First of all, you can automatically reduce your stock of replacement parts. You don't need as many. Parts are interchangeable. You have fewer dollars idling in the stockroom.

Next, you save maintenance costs. Maintenance men quickly become familiar with the standardized Bailey Parts. Repairs take less time. Furthermore, training on a multiplicity of different assemblies is unnecessary.

Tube problems vanish, too, when Bailey Meters are installed. Tubes are the standard, easy-to-get type. Specials and order-from-the-factory variety have been avoided.

If you are crowded for panel space, then by all means get complete information about Bailey Meters and Controls. Write today for a copy of bulletin No. 17. Bailey Meters save panel space.

P-14

4 records, 1 chart

Four instruments occupy the space of one. This four-pen Pyrotron gives the same number of *continuous* records as four separate instruments. A separate system actuates each pen. Each record is in a distinctive color. Units are interchangeable. For complete information about this space-saving instrument ask for bulletin 230-A.

BAILEY METER COMPANY

1047 Ivanhoe Road Cleveland 10, Ohio

Controls FOR THE IRON & STEEL INDUSTRY

Temperature • Pressure • Flow • % Oxygen • % Combustibles • Level • Density • Ratio

THE ENGINEERING MART

WHERE TO BUY
EQUIPMENT FOR SALE
POSITIONS VACANT
POSITIONS WANTED

AN *IRON and STEEL ENGINEER* SERVICE TO THE STEEL MILL OPERATORS

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487 Ellicott Square
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Phone: WA 5459
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Railway & Industrial Engineering Co.
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Manhattan Building
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333 North Michigan Avenue
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Representing:
I-T-E CIRCUIT BREAKER CO.

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HARRY J. FISHER AND ASSOCIATES
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Lapp Insulator Company, Inc.
Pennsylvania Transformer Company
Branch Offices in Youngstown and Akron

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Room 412, Jones Law Building
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ATlantic 2142
Representing electrical manufacturers to Pittsburgh industry.

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Pittsburgh 19, Pa.
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Thomas Flexible Couplings
Telsmith Crushers
Phone: ATlantic 4254

ROLLING MILLS and EQUIPMENT
FRANK B. FOSTER, INC.
2217 OLIVER BUILDING PITTSBURGH 22, PA.
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EDGAR M. MOORE & CO.
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Transformers – Timers – Cable Take-up Reels
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PITTSBURGH (Continued)

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(Air Preheaters)
For application to soaking pits, heating, and other types of metallurgical furnaces.
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Alligator Shears – Portable Cranes – Special Machinery
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PITTSBURGH, PA.
Phone: ATlantic 1535

PENNELL ASSOCIATES
Complete Material Handling Systems
O. R. Heidenrich
Investment Building
PITTSBURGH 22, PA.
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Electric Industrial Trucks
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Heavy Duty Trailers, Skids, Transfer Cars, Skid Dumps
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Bridge Ramps for Car Loading
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All displayed classified advertising is sold in multiples of one inch at the flat rate of $8.00 per column inch. Minimum insertion is one inch. Maximum insertion is one column, 10 inches deep, or two columns, 5 inches deep.

UNDISPLAYED CLASSIFIED ADVERTISING RATES

All undisplayed classified advertising is sold at the rate of $1.00 per line. Five line minimum insertion charge. A box number address counts as one line.

Deadline:

All copy must be received by the 20th of the month preceding publication date.

IRON AND STEEL ENGINEER
1010 EMPIRE BUILDING
PITTSBURGH 22, PA.

THE ENGINEERING MART

PRODUCTS

Acid-Proof Materials

Specify SAUEREISEN
ACIDPROOF CEMENTS—COMPOUNDS
FOR
Tanks, Sewers, Stacks, Floors
Technical cements for all purposes.
Send sketches or samples
Sauereisen Cements Company · Pittsburgh 15, Penna.

EQUIPMENT FOR SALE

FOR SALE
60 New Bridge Sets, Complete.
Each set consists of the following principal items:
Four 30 foot I-Steel Beams, 50 ton posted capacity, Plate Bearing, Clip Traction, Diaphragms Intermediate and Diaphragms end, Floor Clips, Erection Bolts, rough and ribbed, lock washers.
This material on site for immediate delivery.
Address Box 1001, 1010 Empire Building, Pittsburgh, Pennsylvania.

BUSINESS OPPORTUNITIES

WANTED

Copies of "THE MODERN STRIP MILL" published by the AISE. If your copy is not being used why not sell it? For details write to IRON AND STEEL ENGINEER, Box 1000, 1010 Empire Building, Pittsburgh 22, Pennsylvania.

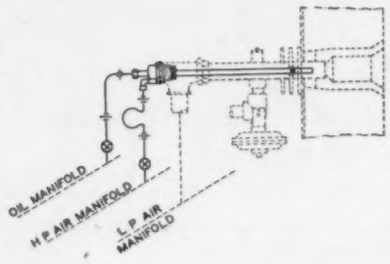
News Supplement

(Continued from page 118)

OIL STANDBY UNITS FOR GAS BURNERS

▲ Surface Combustion Corporation has just announced the availability of oil standby equipment for use with most of its gas burner equipment.

The oil standby equipment utilizes No. 3 furnace oil or lighter and provides the same Btu input/hour as is provided with the gas burner equipment.

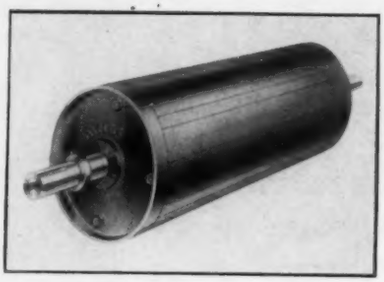


Once installed, Surface oil standby equipment can be quickly changed over during periods of gas curtailment.

MAGNETIC PULLEYS USED IN CONVEYORS

▲ The "Perma-Pulley," a new permanent magnetic pulley with Alnico poles developed by the Dings Magnetic Separator Company is available in 53 sizes ranging from 12 in. diameter by 12 in. width to 30 in. diameter by 60 in. width. Designed for use as head pulleys in a belt conveyor system or in a self-contained magnetic pulley-type separator unit, these magnets are used to remove magnetic substances automatically from non-magnetic materials carried on the belt. Being of permanent magnet construction, no electrical wiring is required. The manufacturer guarantees the magnetic permanence forever provided the magnet is properly used.

The pulley has a crown face to prevent belt weaving and to aid in even distribution of the burden across the belt as it passes over the pulley. Shaft diameters are standard to permit replacement of non-magnetic head pulleys in existing installations without changing bearings or shaft mountings. Head plates of the pulley



These pulleys are of permanent magnet construction.

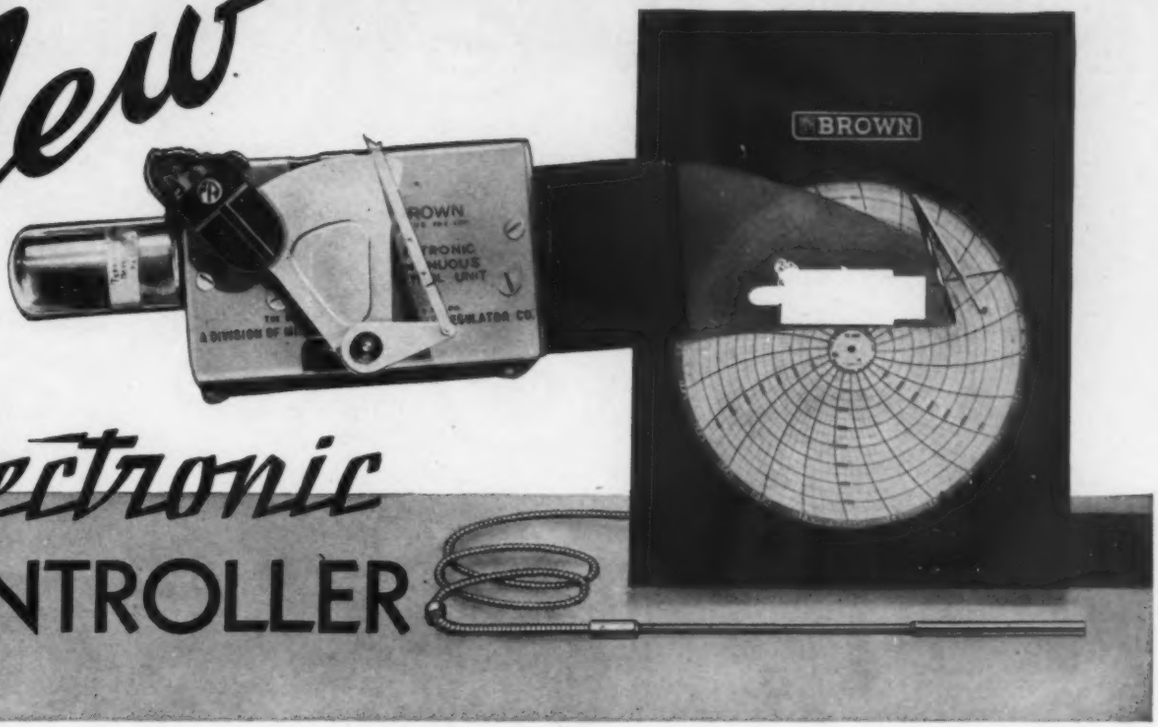
are non-magnetic to prevent collection of magnetic material on the outside edges. A narrow gap design is used with non-magnetic gap plates between the poles and equal magnetic strength across the full width of the belt.

MIT BUYS MILL FOR RESEARCH PROGRAM

▲ A two-high rolling mill for hot and cold rolling of ferrous and non-ferrous metals was recently built by Hydropress, Inc., for the laboratories of the Massachusetts Institute of Technology.

The mill stand shown has a pair of 6 in. diameter by 8 in. face rolls made of special hardened forged steel to withstand hot or cold rolling. They are mounted in heavy-duty roller bearings enclosed in steel chocks. Roll pass settings are made by hand-wheel adjustment and direct readings are made in the micrometer graduated dials. Roll housings are of rolled welded steel and have a post area of 64 sq in. The rolls are driven by means of wobbler and muff-type couplings and spindles completely machined so as to give a smooth running mill. Roll drive pinions are enclosed in a welded housing and are mounted in roller bearings. Reduction gears and pinions have machine-cut teeth and run in a bath of oil in fully enclosed housings. Mill stand and reduction gears are mounted on a common welded bedplate. The mill is driven by a 25 hp motor which drives the reduction unit through V-belts and pulleys. This arrangement allows for simple changing of the roll speed in the future if desired.

New



Electronic CONTROLLER

FOR TEMPERATURES AND PRESSURES

This is the new Brown *Electr-o-Vane* Control Unit. To users of electric contact control Thermometers and Pressure Gauges, it offers a high degree of control performance never before attained.

A true triumph in control, this electronic unit is not merely an adaptation of a known principle but an achievement in design by which all the shortcomings of similar devices are eliminated.

Added to the Brown Thermometer and Pressure Gauge line, the *Electr-o-Vane* Unit provides a control instrument of unequalled performance. No instrument of this type can equal its dependability in service, its precision in operation or its safety features. Brown *Electr-o-Vane* Thermometers and Pressure Gauge Controllers are available *at no premium cost*. With all the exclusive features of these instruments, why compromise with less than the best.

A NEW CATALOG (No. 6001) fully describing the operating principle, features and models of the Brown *Electr-o-Vane* Controllers is now available. Write for your copy today — there is no obligation.

The Brown Instrument Company, 4464 Wayne Ave., Philadelphia 44, Pa.

DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO.

SUBSIDIARY COMPANIES IN TORONTO • MEXICO CITY • LONDON • STOCKHOLM • AMSTERDAM • BRUSSELS

The Brown *Electr-o-Vane* Control Unit operates on the principle that when a metal vane is interposed between two oscillator coils in a unique electronic circuit, the oscillations stop. This stopping of oscillations causes the electronic circuit to operate a load relay.

The oscillator coils are the heart of the controller. Brown oscillator coils are molded in bakelite and are thus *moisture-proof* — an exclusive Brown feature. A knife-edge control action is provided that does not drift. Control action is precise. It never varies. It is unaffected by moisture conditions.

Only the circuit used in the Brown *Electr-o-Vane* Control Unit causes an actual stop in oscillations. That is why this is the only instrument of its type providing real *snap action* — an important factor for precision control

Brown *Electr-o-Vane* Control is contained in a neat, compact unit. It is self-contained, easily removed as a unit and unaffected by dust or dirt.

Electr-O-Vane

BROWN

Electr-O-Vane THERMOMETER CONTROLLERS

CRESCENT PALLETIER FORK TRUCK

DEPENDABLE

POWER

EXIDE-IRONCLAD POWER
AND BATTERY ELECTRIC TRUCKS

They're saving time and cutting costs on materials handling jobs like yours

More and more companies, with operating conditions that closely parallel yours, have discovered the way to faster, safer and more economical handling of materials. They have given the job of lifting, hauling and stacking to the efficient battery electric truck and equally efficient Exide-Ironclad Batteries.

The high electrical efficiency of Exide-Ironclad Batteries is due largely to the unique construction of the positive plates. Each of these plates consists of a series of slotted, hollow tubes which contain the active material. So fine are these slots that, while they permit easy access of the electrolyte, they prevent the active material from readily washing out. Not only does this add to life of plates . . . and battery . . . it also provides higher power ability and capacity, assuring dependable, day long performance with maximum safety and minimum maintenance.

Write us for a FREE copy of Exide-Ironclad Topics, which contains "Case Studies" of materials handling problems. It tells how to cut handling costs up to 50% . . . covers latest developments in handling materials from receiving to shipping.

THE ELECTRIC STORAGE BATTERY COMPANY
Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

CRESCENT PALLETIER FORK TRUCK

FOR DEPENDABLE CRANE PERFORMANCE
USE CLARK CONTROL

THIS

PLUS

THIS

EQUALS

THIS

A Standard Crane Installation PLUS a Clark Bulletin 9135, D.C. Form M, Dynamic Braking High Speed Lowering Control Panel EQUALS good operating characteristics.

Curves (lower right) are averages obtained from a large number of installations. They represent general performance characteristics. Some variations depend upon crane efficiency and actual load on the motor with full load on the hook.

FEATURES OF BULLETIN 9135 CRANE HOIST CONTROL

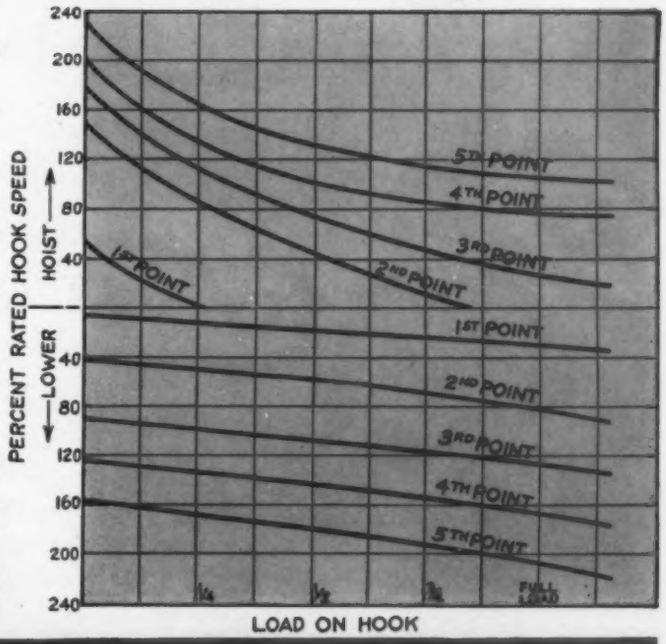
1. Slow creeping speed available both hoist and lower directions for accurate spotting of loads.
2. High speed no load hoisting and lowering speeds for rapid movement of empty hook.
3. Dynamic braking at off point to aid magnetic brake in stopping load.
4. Vari-Time controlled acceleration both hoisting and lowering.
5. Rapid reversals from hoist to lower and vice versa cannot damage the motor protection inherent in the control system against this motor abuse.
6. Certain applications require a very slow speed with high torque first point hoist. An armature shunt contactor can be provided for this condition.

Clark Bul. 9136 D.C. Magnetic, Reversing, Plugging Bridge and Trolley Controllers complete an electrical control installation that gives maximum satisfactory crane performance.

AVAILABLE CLARK "3C" ACCESSORIES

Master Switches—Magnetic and Hydraulic Brakes—Edgewound and Cast Grid Resistors—Crane Hook Limit Switches.

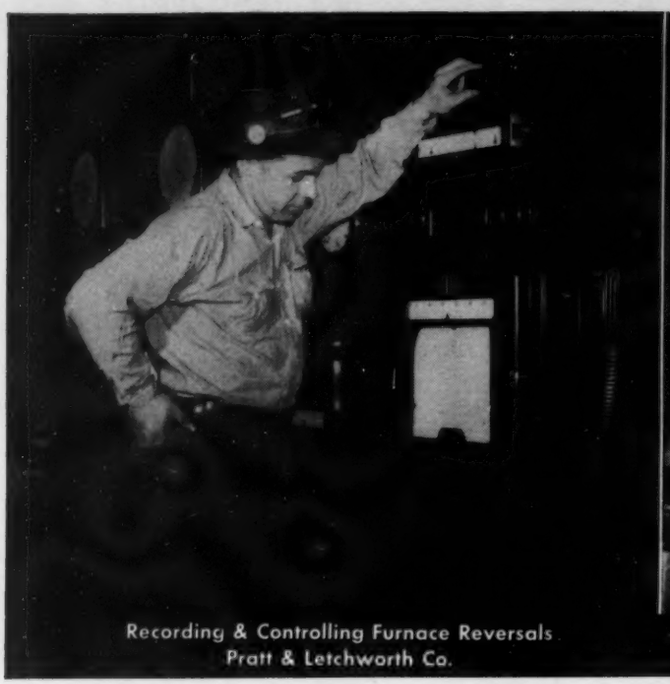
CLARK STANDARDIZED FULL MAGNETIC D. C. CRANE CONTROLLERS ARE AVAILABLE ON A 6 TO 8 WEEK DELIVERY SCHEDULE



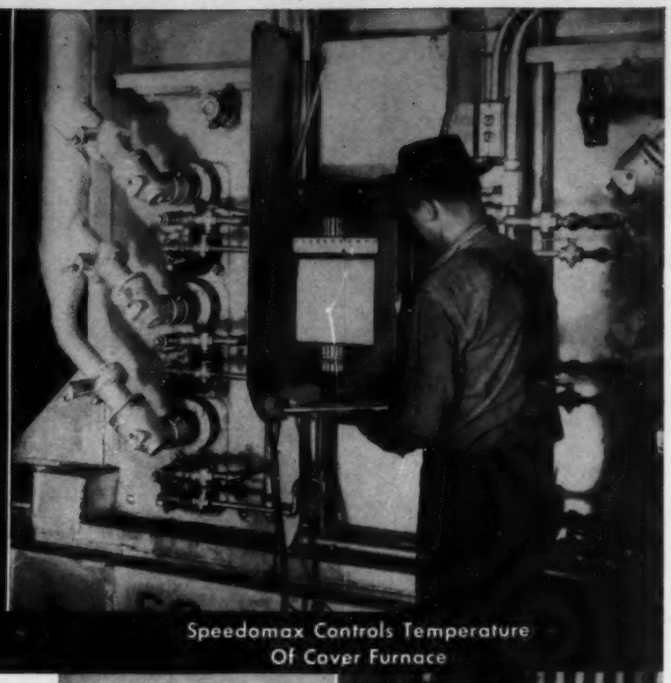
EVERYTHING UNDER CONTROL

THE CLARK CONTROLLER CO.

1146 EAST 152nd STREET, CLEVELAND 10, OHIO



Recording & Controlling Furnace Reversals
Pratt & Letchworth Co.



Speedomax Controls Temperature
Of Cover Furnace

Recorders and Controllers for "EVERYBODY"

Did you ever try this way of selecting the correct Recorders or Controllers for a process?

First step is an analysis of basic requirements (with our help, if you wish) to include such factors as:

Type of Control action if any — on-and-off; fully proportioning; manual based on instrument readings.

Type of Control mechanism — pneumatic or electric.

Type of instrument — recording or non-recording; single-point or multiple; round-chart or strip; speed of response.

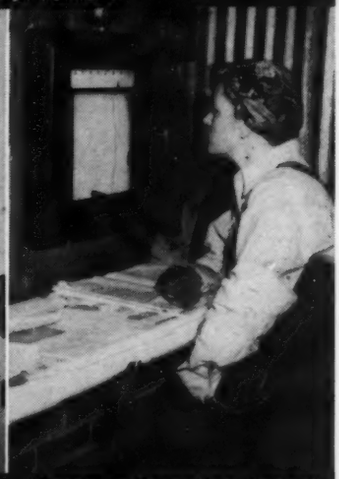
Inherent characteristics of the process, which help determine the correct instrumentation.

Meeting Industry's Need for Stable Control.

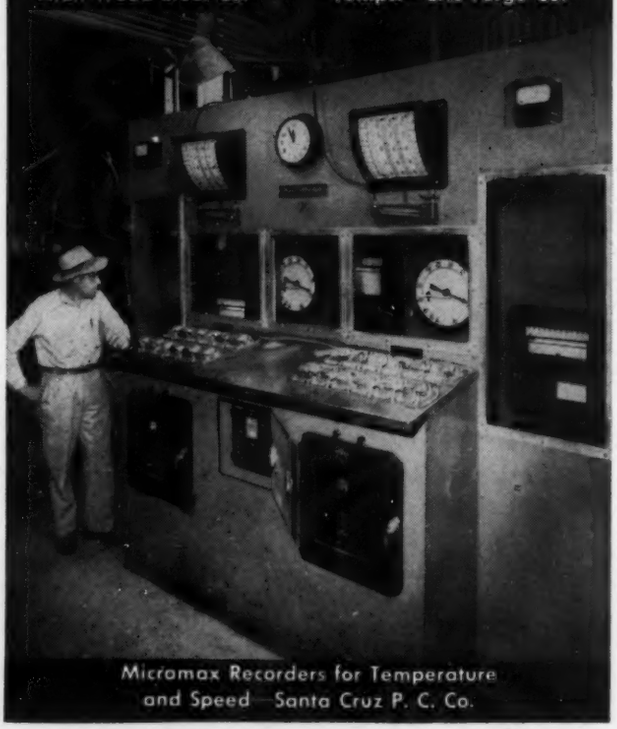
For any combination of requirements which may appear, Micromax and/or Speedomax instruments meet the need — exactly and completely. And they do more — they contribute a highly *stable, continuous* control, which helps your plant maintain production continuously.

This quality of stability of course includes accuracy, but stability's real value is to *make accuracy useful.* Stability means "no interference" by weather, temperature, vibration, dust, electric fields, etc. Stability enables Micromax and/or Speedomax to meet the needs of almost "everybody." For details, write Leeds & Northrup Company, 4942 Stenton Ave., Philadelphia 44, Pennsylvania.

Speedomax Recorder
Alan Wood Steel Co.



Micromax Recording Anneal
Temps.—Erie Forge Co.



Micromax Recorders for Temperature
and Speed—Santa Cruz P. C. Co.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · AUTOMATIC CONTROLS · TELEMETERS
HEAT-TREATING FURNACES

Jrl. Ad ND4(1)

INDEX TO ADVERTISERS

A

Aetna Standard Engineering Company 1
Air Reduction Sales Company 5
Alliance Machine Company 127
Aluminum Company of America 7
American Brakeblok Division,
American Brake Shoe Company 139
American Chemical Paint Company 108
American Hammered Piston Ring Division
of Koppers Company 120, 121
Askania Regulator Company 144
Automatic Transportation Company 23

B

Babcock & Wilcox Company, The 20
Bailey Meter Company 146
Baker Industrial Truck Division,
The Baker-Raulang Company 13
Bantam Bearings Division,
The Torrington Company 10
Bedford Foundry and Machine Company 128
Birdsboro Steel Foundry and
Machine Company 92, 93
Blaw-Knox Division, Blaw-Knox Company 106
Bloom Engineering Company 111
Bonnot Company 135
Bowser, Inc. 129
Brassert & Company, Inc., H. A. 32
Brown Instrument Company 149
Buffalo Forge Company 96
Bussmann Manufacturing Company 90, 91

C

Clark Controller Company 151
Cleveland Crane and Engineering Company 28
Cleveland Worm and Gear Company, The ..... Cover 3
Continental Foundry and Machine Company 99
Crane Company 134
Crocker-Wheeler Electric Manufacturing
Company 131
Crouse-Hinds Company 22
Cunningham Company, M. E. 133
Cutler-Hammer, Inc. ..... Cover 2

D

De Laval Steam Turbine Company 100
Deltabeston Division,
General Electric Company 115
Dixon Crucible Company, Joseph 114
Dowell, Inc. 98
Durabla Manufacturing Company 4

E

Electric Controller and Manufacturing Company 16
Electric Storage Battery Company 150
Engineering and Construction Division
of Koppers Company 120, 121

F

Falcon Bronze Company 132
Farrel-Birmingham Company, Inc. 118
Flinn and Dreffein Company 32

G

Gamlen Chemical Company 133
Gas and Coke Division
of Koppers Company 120, 121
General Electric Company ..... Cover 4, 26, 27

H

Hagan Corporation 15
Halliden Machine Company 32
Hays Corporation, The 109

I

International Graphite and
Electrode Corporation 12
International Nickel Company 141
I-T-E Circuit Breaker Company 110

J

Johns-Manville Corporation 97
Jones Foundry and Machine Company, W. A. 136

K

Kling Brothers Engineering Works 126
Koppers Company, Inc. 120, 121
Koppers Coal Company, The 120, 121
Koppers-Rheolaveur Company 120, 121

L

Leeds and Northrup Company 152
Lewis Foundry and Machine Division,
Blaw-Knox Company 11
Lincoln Engineering Company 142
Linde Air Products Company 143
Link-Belt Company 119
Lintern Corporation 130
Loftus Engineering Corporation 122

M

Mackintosh-Hemphill Company 101
Maryland Drydock Company, The 120, 121
McKay Machine Company 32
Medart Company, The 118
Mesta Machine Company ..... Cover 1
Morgan Construction Company 107
Morgan Engineering Company 116
Murray Manufacturing Company, D. J. 132

N

National Bearing Division,
American Brake Shoe Company 102
National Carbon Company, Inc. 124
National Roll & Foundry Company 2
New York and New Jersey Lubricant Company 133
North American Manufacturing Company 95

O

Okonite Company, The 31

P

Peerless Pump Division,
Food Machinery Corporation 113
Pennsylvania Transformer Company 94
Pittsburgh Lectromelt Furnace Corporation 34
Pittsburgh Rolls Division,
Blaw-Knox Company 30
Poole Foundry and Machine Company 123
Post-Glover Electric Company 18
Pyle-National Company 137

R

Reliance Electric and Engineering Company 14
Rockbestos Products Corporation 138

S

Salem Engineering Company 5
Shops Division of Koppers Company 120, 126
Silent Hoist and Crane Company 101
Smeeth-Harwood Company 128
Steel Processing Company 117

T

Tar and Chemical Division
of Koppers Company 120, 121
Texas Company, The 9
Timken Roller Bearing Company 3
Torrington Manufacturing Company, The 112

U

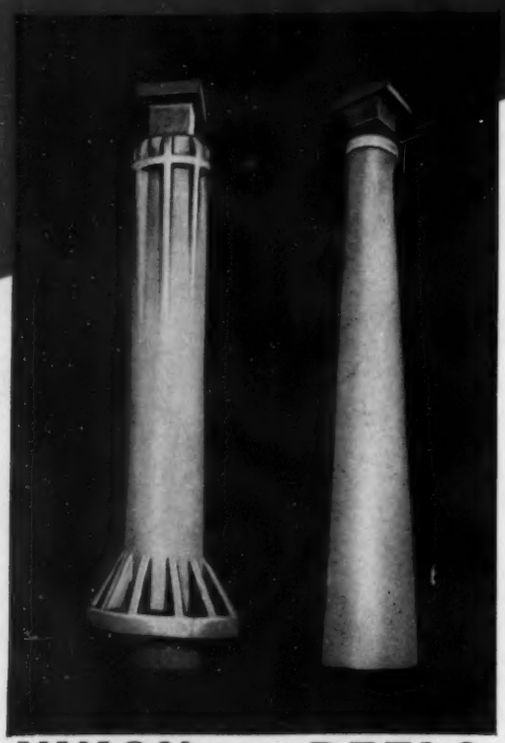
Union Carbide & Carbon Corporation 124, 143
Union Steel Castings Division,
Blaw-Knox Company 154
United Engineering and Foundry Company 17

W

Wagner Electric Corporation 8
Wean Engineering Company, Inc., The 32
Wean Engineering Company
of Canada, Limited 32
Wean Equipment Corporation 32
Western Gas Division
of Koppers Company 120, 121
Westinghouse Electric Corporation 24, 25
White Tar Company
of New Jersey, Inc., The 120, 121
Wilson Engineering Company, Inc., Lee 21
Wing Manufacturing Company, L. J. 105
Wood Preserving Corporation, The 120, 121

FOR HOTTER FUELS

BIGGER LOADS



UNION ALLOY STEEL PEELS

Except for the charge itself, no piece of unprotected metal is subjected to greater heat for a longer time than the peel. And, hot or cold, it must withstand severe shock and stresses as well. "Union" has developed for this tough service peels of heat and shock resistant alloys in designs that add months to their useful life. ... Glad to quote from your specifications on either rough or fully machined castings.

UNION DOUBLE LIFE HEAD CHARGING BOXES

You'll be quick to see and appreciate the difference! That specially designed, reinforced head means "double life" without cracking or distortion ... All square corners have been replaced by round ones which lend themselves to better casting process ... Union Boxes are cast from UNIVAN—a special nickel-vanadium steel that maintains its superior strength under extreme conditions of heat, cold and shock ... Whether you operate with 20, 25, 36 or even 50 cu. ft. capacity charging boxes, we welcome the opportunity to prove that you can do a faster charging job for a longer time at less cost with Union Double Life Head Boxes ... Your request for further details and prices will receive immediate attention.

"UNIVAN" Reg. U.S. Pat. Off.

UNION STEEL CASTINGS

DIVISION OF BLAW-KNOX CO., PITTSBURGH, PA.

Cinder Pots • Slag Pots • Coupling Boxes • Spindles • Gears • Bells and Hoppers • Ingot Cars • Charging Cars • Annealing Boxes and Bases

As the white outline indicates, a standard unit of much greater frame size would be required to do the work of Speedaire.

Calcimine can't slow up SPEEDAIRE

DUST accumulates quickly on everything in this New Jersey Calcimine plant, but it does not impair Speedaire's capacity or efficiency. Speedaire was selected for this job, over a conventional worm gear drive, first, because Speedaire's powerful fan keeps the internal surfaces clean and cool, and second because of the saving in space, weight and cost. The money saved was $117.00.

Speedaire is Cleveland's new fan-cooled worm-gear speed reducer. Because it is fan-cooled, Speedaire will do more work—will deliver up to *double the horsepower* of standard worm units of equal frame size, at usual motor speeds. It can be installed economically on many applications where other types have been used heretofore—giving you the advantage of a compact right-angle drive. Speedaire gives the same long, trouble-free service characteristic of all Clevelands.

For full description, send for Catalog 300. The Cleveland Worm & Gear Co., 3278 E. 80th St., Cleveland 4, O.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

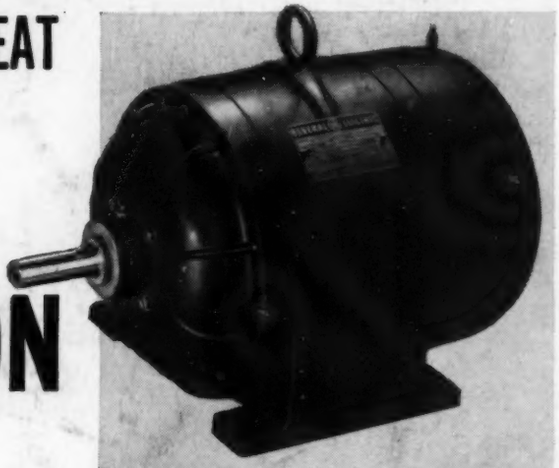
CLEVELAND
Worm Gear
Speed Reducers

4 MILLION HP CONFIRMS IT

FOR TOUGH MOTOR JOBS, YOU CAN'T BEAT

TRI/CLAD

EXTRA PROTECTION



To date, a million and a half Tri-Clad motors, with a total output of over 4-million horsepower, have been purchased by American industry!

In every kind of plant from steel mill to dairy, these motors are proof beyond doubt that you can't beat Tri-Clad extra protection for tough motor applications. Even on jobs where special protective enclosures would ordinarily have been specified, Tri-Clad open motors, applied during the war years, have stood up to heat, dust, and dampness, operating smoothly and efficiently for years with only minimum maintenance.

Today, the Tri-Clad motor family includes many different types and sizes. But whatever your selection, the Tri-Clad motor nameplate is still your best assurance of a high return on your motor dollar. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

EXTRA PROTECTION . . . AGAINST PHYSICAL DAMAGE!

Rigid cast-iron frame and end shields protect vital motor parts from external abuse. Because they're not at the mercy of a coat of paint, they strongly resist chemical attack and dampness. Cast iron also gives you wide, nonyielding fits between end shields and frame for ease of assembly.

EXTRA PROTECTION . . . AGAINST ELECTRICAL BREAKDOWN!

Motor windings of Formex* wire, together with improved insulating materials, reduce the chances of electrical failure. Heat is dissipated quickly —motor stays young for years and years!

EXTRA PROTECTION . . . AGAINST OPERATING WEAR AND TEAR!

Bearing design affords longer life, greater capacity, improved lubrication features. Bearing seals retain lubricant, keep out dirt. One-piece, cast-aluminum rotor is practically indestructible.

*Trade-mark Reg. U.S. Pat. Off.

The toughest *TRI/CLAD* ever built!

Newest addition to the Tri-Clad motor family is the Tri-Clad totally enclosed, fan-cooled motor for use in adverse atmospheres. It gives you these important construction features:

- *A cast-iron, double wall frame which completely encloses and protects the windings and punchings.*
- *A nonshrinking compound around motor leads which protects motor interior from dust and moisture.*
- *A rotating labyrinth seal which further protects the motor interior from damage by foreign matter.*

In many steel plants, Tri-Clad totally enclosed, fan-cooled motors are giving superior service. They have many applications as auxiliary drives on equipment operating in adverse atmospheres. They are widely used as drives on such units as exhaust fans, furnace blowers, hydraulic pumps, lubrication pumps, and grease systems. Their extra protective enclosures allow them to stand up in dirty and hot atmospheres, to give dependable, long-life service with only routine maintenance and inspection.

Behind the unusually fine service record of these motors is the extra protection built into every Tri-Clad motor to give you better performance at lower costs.

GENERAL ELECTRIC

TRI/CLAD

REG. U.S. PAT. OFF.

MOTORS

- OPEN (DRIPPROOF)
- TOTALLY ENCLOSED
- EXPLOSION - PROOF